SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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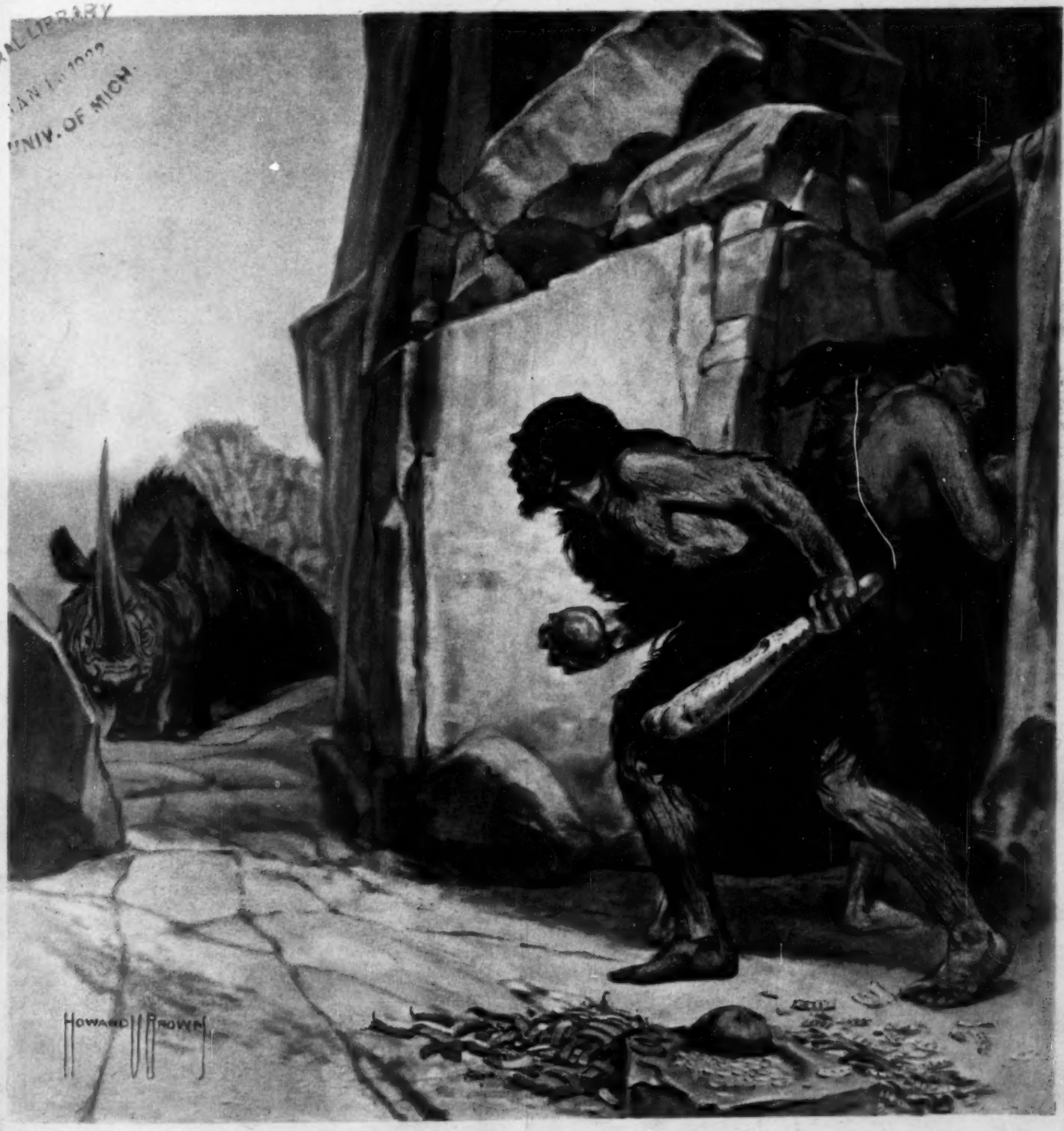
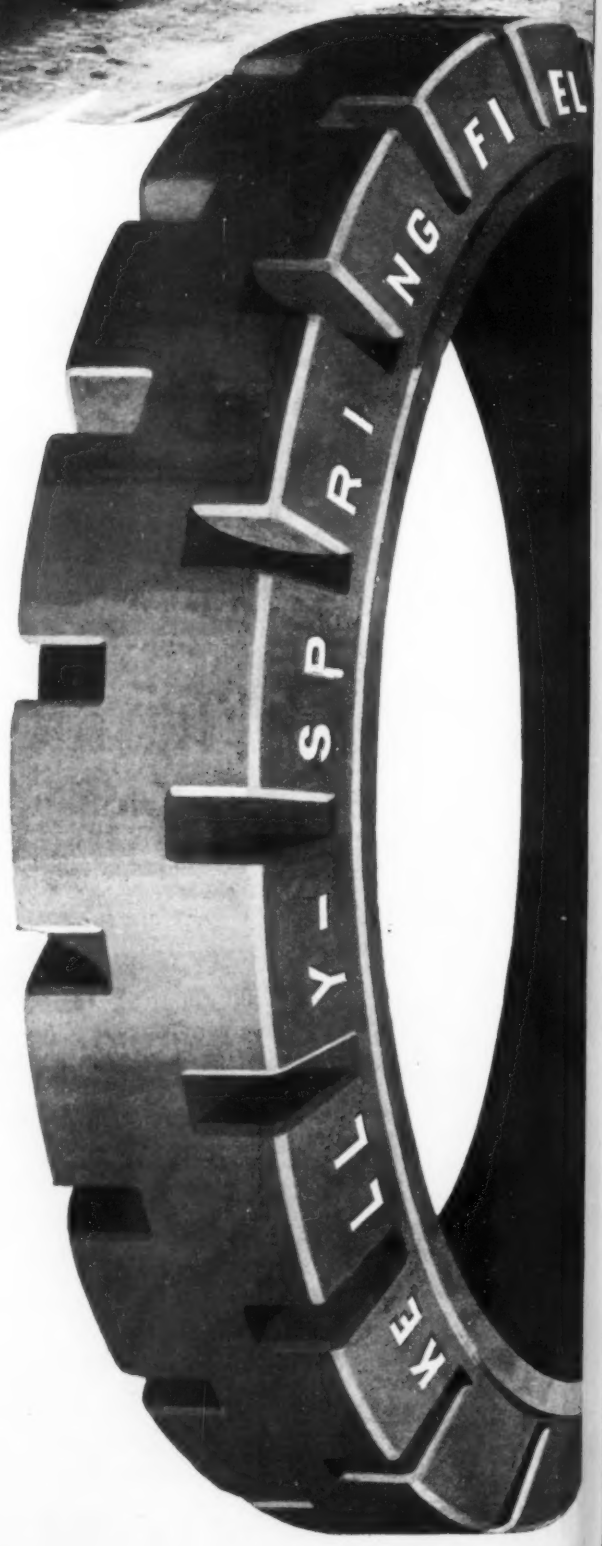


AN INCIDENT OF PREHISTORIC LIFE: THE RHODESIAN CAVE MAN STARTLED BY AN INTRUDER.—[See page 90]

Scientific American Publishing Co., Munn & Co., New York



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You have now come with us to the fourth issue of the *Scientific American* in the new monthly form, and you have been through the strenuous publishing days when two distinct periodicals—*Scientific American* and *Scientific American Monthly*—had to be discontinued at one and the same time with the preparation of this new and greater magazine. In the days of transition we gave promise of many new improvements, that the bettering of your *Scientific American* had only been begun.

One of the promises made at the inception of this new journal was the almost total freedom from "Continued on Page —" and so we have eliminated almost entirely the turning from page to page to complete an article. Besides the irksomeness of constant "turn-overs" this new feature makes *Scientific American* more valuable to the vast host of readers who use the articles in its columns for clipping and reference work.

As the November, December and January issues have come and gone, improvements have followed on improvements, the new stride of the monthly allowing far greater editorial opportunities. In step with these opportunities, the *Scientific American* has incorporated important writers on its already very comprehensive list of corresponding editors. Men of recognized authority in their fields, their articles lend greater scope to the reading—among the new Corresponding Editors are such men as Edward G. Spaulding, Ph.D., LL.D., Princeton University; Samuel J. Record, Professor of Forest Products, Yale University; Saul Dushman, Ph.D., G. E. Research Laboratory; Leon A. Hausman, Ph.D., Cornell; M. Luckiesh, Director of Applied Science, Nela Research Laboratories; W. A. Murrill, Ph.D., New York Botanical Garden.

Science has taken us today to the farthermost corners of the globe. The *Scientific American* editors have long since stopped to think in terms of New York, Chicago, San Francisco and other American cities. Today they are thinking in terms of Peking, Petrograd, Paris, Cape Town, Calcutta, Vienna, Sydney, Buenos Aires, and so on. To that end we have secured correspondents in various parts of the world, supplementing the hundreds of foreign periodicals which come to us monthly for abstracting.

There is no greater hobby these days than Radio. Over 300,000 radio amateurs in this country give ample proof of this, and it is our purpose therefore to keep close watch on all radio developments, and to report current achievements of broad interest to this great group of radio enthusiasts. It is in keeping with the scientific spirit of this great journal to foster the developments in the many fields of science—a policy that has been followed for 77 long years.

For future days there is a great mission for the *Scientific American*, and that is to blaze the trail in *new* sciences. Fearlessly, yet cautiously, it has investigated unknown realms of science heretofore left to others to explore and develop. The psychic science is one of these, and during the months to come we intend to present the leading opinions of the world on this fascinating side of science.

For the expert and the man who puts the columns of *Scientific American* into daily application, the various departments will offer boundless information in tabloid form. Large numbers of domestic and foreign periodicals, government reports, papers of scientific societies, engineering reports; all submit to the boiling down process for the reader's assistance.

The year 1922 is certain to be rich in technical achievements. Recovering from the major effects of the World War, all nations are now getting down to hard work. This laying aside of the frock coat and donning the overalls must have a far-reaching effect. Scientific research turns from destroying life to making this world a better, more efficient and happier place to live in. And in proportion, the work of *Scientific American* has become all the greater—all the more important.

Today, and throughout 1922, you cannot afford to be without the *Scientific American* for guidance, information and keeping abreast of the best achievements of man.

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With the Editors

I IMAGINE hundreds of thousands of pairs of critical eyes, backed up by trained and analytical minds, going over your work month by month. Yet that is precisely our experience. Frankly, we do not know of a more critical audience than our readers; and we are glad, even proud, to be the purveyors of practical information to that very audience, even though it does mean an occasional word of criticism when an editorial gear gets out of mesh. Thus we recently made a rather unfortunate choice of words in describing a high-voltage electrical experiment. No sooner was that issue in the hands of our readers than we received letter after letter, pointing out the awkwardness of our statement. Our meaning was clear, to be sure, but our readers suggested how another and totally inaccurate meaning could be read into our statement. Then we had the sinking of a battleship, and we confounded the bow with the stern. Again the critics got busy. And so it goes. Still, that is precisely as it should be, for if the SCIENTIFIC AMERICAN is not keyed up to the highest possible standard of accuracy at all times, it must needs lose much of its value.

BY the way, we said at the beginning of the foregoing note that several hundred thousand pairs of critical eyes went over our work month by month. This brings another thought to mind and calls for an explanation. While our circulation is actually in the neighborhood of 100,000 copies per month, each copy is read by a number of persons, just how many we do not know. So the total number of readers is far in excess of 100,000; it must be at least half a million. Librarians will tell you that there is more call for the SCIENTIFIC AMERICAN than for any other periodical. We know of a wealthy farmer, down South, who subscribes for this journal. After he gets through reading it, he mails it to a relative, up North, who reads it in turn and passes it on to his father. The father, when he is through with it, passes it on to another friend, and from that friend the dog-eared paper, considerably the worse from such wear, finds its way to a hospital, there to be read by many more persons. Little wonder that the humorous member of our staff, after hearing about this case, suggested that we print the magazine with perishable ink, which would be visible only long enough for one reader to get through it!

THE topic of the hour is radio. Overnight, a nation-wide interest in radio has come into being, because of the establishing of several radio telephone broadcasting stations in various parts of the country. Only a few weeks ago, one of our members was invited to deliver a talk on amateur radio at the broadcasting station in Newark, N. J. This he did, and he was heard by an unnumbered audience over thousands of square miles. One amateur located in Clinton, Iowa, wrote in saying how he had enjoyed every word of that speech — over a distance of 1000 miles, mind you! The writer of these lines also wanted to hear his brother editor's speech, so he took home with him that evening a miscellaneous collection of batteries, telephones, wire, receiving set, vacuum tubes, insulators, and so on. It was the work of but a half hour to connect the equipment and throw a 60-foot wire out of the second-story window. The dry cells, due to the three-ampere drain made by the vacuum tubes, did not stand up, and the beginning of said brother editor's talk was completely lost. But then the writer remembered the neighbor's Ford and the storage battery contained therein. Once the storage battery was installed, excellent results are obtained. The tail end of the talk was readily picked up—clear and loud, over a distance of some fifty miles, with high hills intervening; then came the news of the day, musical selections, stock reports, official time signals, etc. So enthused have we become over this radio idea that we are preparing a long and explicit article for the March issue, telling all about these broadcasting stations, where they are located, what kind of equipment is necessary at various distances away to intercept the messages and music, and how to install said equipment. Furthermore, we are prepared to answer all inquiries on this subject.

WE have been criticized for the absence of the "human element" from our pages. With the reservation that the human element is hidden in every piece of machinery if we but search for it with the thought in mind of what the use of the new apparatus means to men, we can plead guilty to this indictment. It is a fact that our field involves things rather than people, and that it is seldom that actual personalities are in their place in our columns. Occasionally there is an exception, however. Such was the Edison story in our first monthly issue, which was distinctly scientific, while permeated throughout with Mr. Edison's personality. Such again is the story which Mr. Collins tells us of Mr. Wood in the present issue —a tale of a wonderful new machine which would have failed, temporarily at least, if it had been introduced strictly on its merits, and without the personality of the man behind it to push it through.

THE fuel problem is always with us. Sometimes its discussion takes the form of a proposal to save fuel by substituting the water-power sources which are used without being used up. Sometimes it has to do with the measures which are quietly taking shape behind the scenes, to enable us to go on driving our automobiles after we have exhausted the underground stores of liquid petroleum. Sometimes it turns about the issue of fuel for steam. This month the fuel problem is with us in considerable detail. Mr. Skerrett catlogs our resources in fuels of all descriptions. Mr. Dacy tells us what we may reasonably expect from the lower members of the coal family, which have not heretofore been called upon to support their fair share of our industrial establishment. And Mr. Dachnowski puts before us the need of examining, with the utmost care and the utmost system, every possibility, however crude the raw material with which it may be concerned.

THE editors have rather got in the way of looking forward to the receipt of a bulky package bearing the Ithaca postmark, and containing a manuscript and a collection of pictures setting forth Dr. Hausman's latest doings. His work possesses a rare combination of immediate practical value, interest alike to the eye and the mind, and susceptibility of being described in rich detail, without embarrassment to the reader of average attainments. We hope that the people who buy the SCIENTIFIC AMERICAN are as well pleased with what Dr. Hausman tells them, in this and other issues, and with the way in which he tells it, as are those of us who make the paper.

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SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

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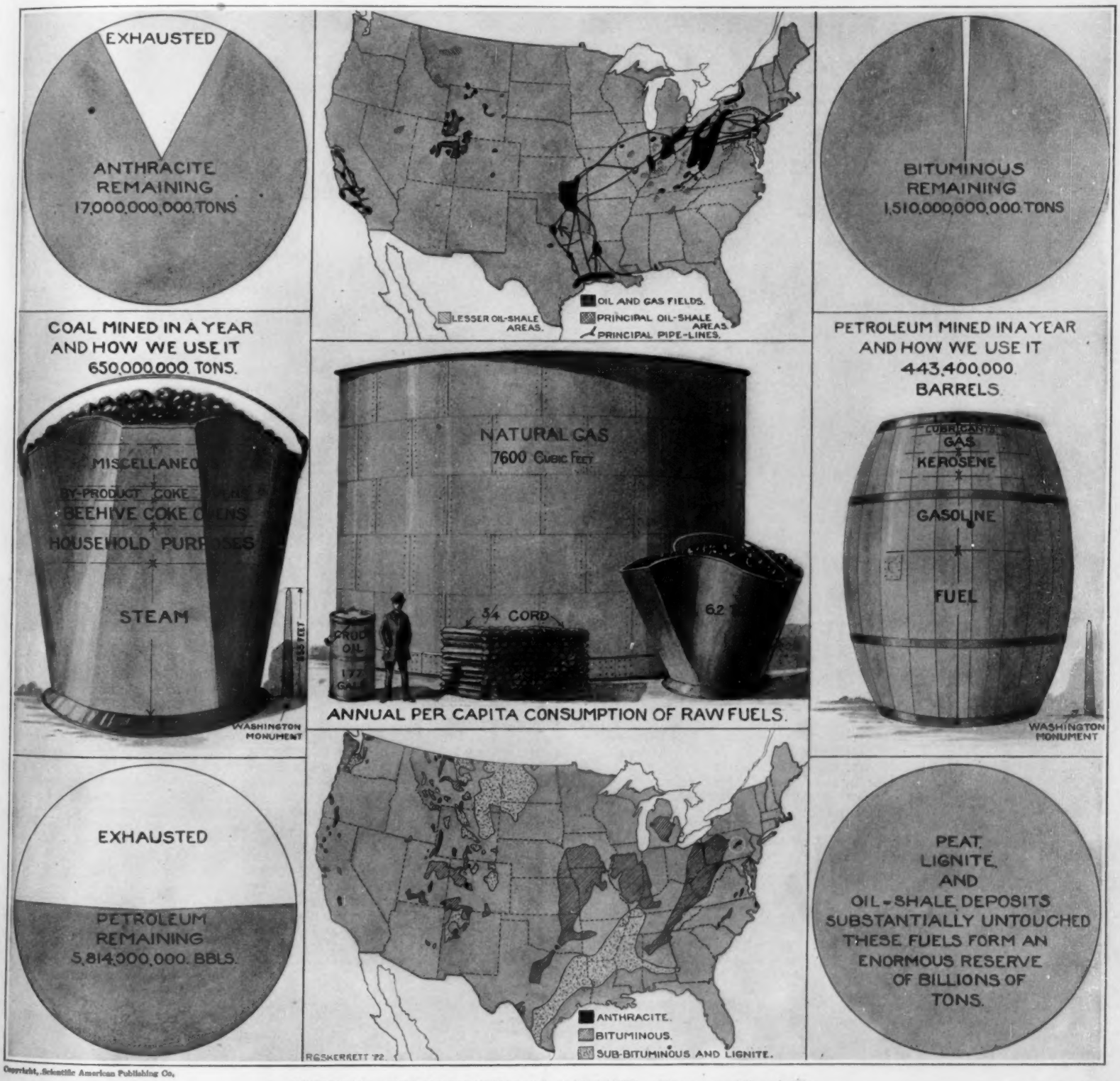


AMERICA'S FUEL RESOURCES AT A GLANCE.—(See pages 86 and 87)

America's Fuel Resources

What We Have and How We Are Using Them

By Robert G. Skerrett

FLAME meant, in fact, far less to those primitive peoples who bowed in superstitious reverence to fire than it does now to a civilized world which takes it largely as a matter of course.

The whole of our modern standard of life; the foundation of our many-sided manufacturing activity; the carriage of a vast tonnage of commodities; and most of the comforts and conveniences which we deem indispensable are, in the main, the reflexes of present-day adaptations of flame. In short, we have turned fire to our purposes by making it the dominating source of energy—mechanical energy; we have transformed the sacrificial glimmer of the past into the dazzling glare of the industrial furnace. How many of us stop to think whence come the fuels essential to these varied services? Most of us give the subject little if any heed, and deem our supplies inexhaustible.

When we first established ourselves permanently upon this continent, dense forests covered the land well-nigh from the very shores of the Atlantic to way beyond the western limits of the Mississippi Valley. The stands of timber for generations thereafter provided lumber for most of the homes reared for the gathering population and furnished the while fuel for the fireside, the shop, the mill, and the factory. All of us know how we have ravaged our primeval forests; how we have reduced the measure of native lumber and the size of the domestic woodpile.

When the white man came to America to stay, 300 years ago, nature had stored underground for his future use coals of all sorts to the measure of 3,541,000,000,000 tons; and undreamed-of subterranean oil pools held an aggregate of 11,200,000,000 barrels of petroleum. Associated with the latter were incalculable trillions of cubic feet of natural gas. No one then realized the drains that would subsequently be made upon these age-old accumulations of potential heat and motive force. The story of what has since taken place points a lesson which every one of us should ponder and learn by heart, for how we profit by it, how we mend our ways, intimately concern our whole social and industrial structure and our economic future.

According to the census of 1820 the population of the United States numbered 9,638,453. Up to that time we had mined and consumed the modest amount of 15,000 tons of coal, four-fifths of which was anthracite from the Pennsylvania fields. This fact, certified to by the U. S. Geological Survey, makes it plain that the nation at large relied almost wholly upon its timber lands for fuel. Even as recently as 1860 the consumption of coal per capita did not exceed half a ton annually; and in 1880 our coal production reached only 71,481,570 tons—the equivalent of an allowance of 1.42 tons per person that year. The latest figures, however, show that we are taking out of our mines each twelve-month an average of 650,000,000 tons of coal, both bituminous and anthracite, which is tantamount to six tons per capita. That is to say, out of a combined original deposit of anthracite, bituminous, and lignite coals we have used up since 1807 a matter of substantially 14,000,000,000 tons. This leaves us the tremendous total of 3,527,000,000,000 tons to draw upon. To be more specific, this reserve is made up of 17,000,000,000 tons of anthracite, 1,510,000,000,000 tons of bituminous coal, and 2,000,000,000,000 tons of lignite.

Our lignites are substantially untouched; from our bituminous store we have withdrawn less than 1 per cent of the original deposit; but the veins of anthracite have been so worked that at the present trend of consumption it is prophesied we shall exhaust them within the next 75 years. On the face of it, it seems that we have no cause for worry, but analysis reveals that there is ample warrant for concern. What are we going to use in place of anthracite when that smokeless fuel is no longer to be had, at least at a price that would make its burning economically feasible? All of our anthracite comes from a region in Pennsylvania covering an area of something under 500 square miles, while our bituminous coals are mined in no fewer than 30 States.

The coal storage shown in part in this view is located on the west bank of the Hudson River, facing New York City. It contains over 240,000 tons of coal and is the fuel reserve of a New York electric light and power company. The big public utilities have to store large quantities of coal to tide them over in case of emergency

What coaling of a big city really means: one of New York's coal storages

Apart from its smokelessness, anthracite has generally a high-heating value, and is therefore peculiarly suited for domestic purposes. Because of this the anthracite of Pennsylvania is distributed broadcast to consumers located within a region reaching east to Maine, west to Minnesota, and south to Georgia. Not only that, but the ordinances of many municipalities strictly prohibit the burning of bituminous coal within the city limits. This is done in the name of public health, protection of property, the avoidance of atmospheric pollution and the scattering of grime hither and thither. Our citizenry can not, for the reasons cited, view with indifference the approach of a day when bituminous coal, with its clouds of dense, black smoke, might have to be substituted for cleanly anthracite.

Exclusive of our steam railways we had in service in 1870 engines in our factories, mines, and quarries aggregating 2,460,832 horsepower. Today these same industries have steam plants totaling 31,250,000 horsepower. Our steam railroads now have at their disposal 50,000,000 horsepower; and if we add our steam and naval vessels, central stations, electric railways, and other enterprises using fuel for motive force, we have working for us 96,000,000 steam-generated horsepower. This employment of mechanical energy indicates how we have developed within the span of half a century; and explains in part why we are making steadily increasing inroads upon our coal fields. Besides having greatly advanced industrially in the last five decades our standards of living have mounted upon a corresponding scale.

The quantities of coal mined annually, however, are not a true index of our amplified use of motive energy, because liquid fuel has been utilized more and more for the raising of steam and for direct propulsion through the medium of the internal combustion engine. This state of affairs is familiar to all of us and is especially emphasized by the continually growing number of automotive vehicles seen on our streets and roads and by the ever-widening adoption of the gasoline-driven tractor on the farm.

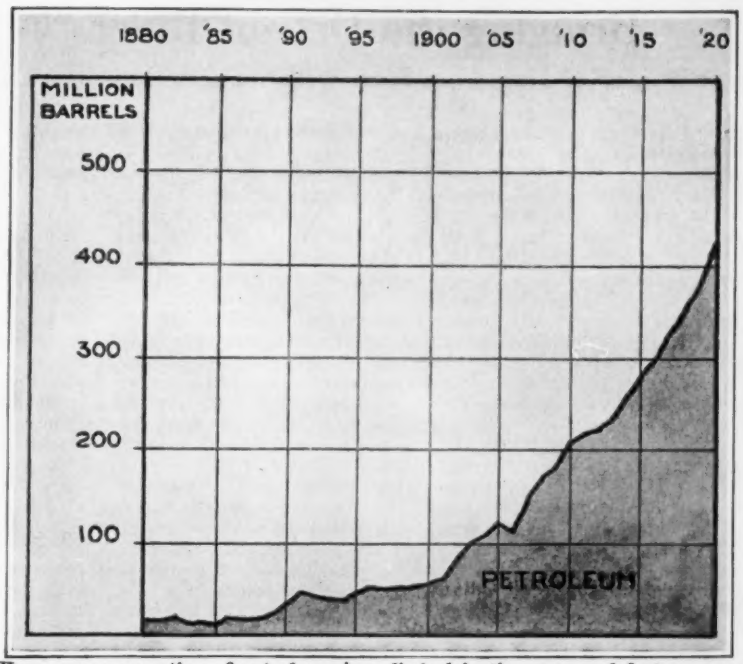
No one realized, in 1859, when petroleum was first struck in Pennsylvania, that the discovery of that oil was to effect profoundly our national life in many directions. In that year we drew from the ground 2000 barrels of the fluid; and there was a period, for some time afterward, when the output ranged between 2,000,000 and 3,000,000 barrels annually. It could be bought during that interval of moderate demand for a few cents a barrel; in short, the stuff was well-nigh a drug on the market.

Up to 1902 our employment of petroleum developed gradually, and until then our oil fields in the eastern areas of the country satisfied our needs. From that time on we have exploited extensively and successfully the Mid-Continent and the western sections of our oil-bearing lands, and today the Eastern Appalachian pools have become of minor importance. Indeed, in 1920 the latter region yielded but 30,500,000 barrels, while the Mid-Continent wells produced 249,000,000 barrels, and from California alone we obtained in the course of that twelvemonth nearly 106,000,000 barrels. From all our fields, two years back, we drew about 444,000,000 barrels. Since 1859 we have removed from our oil sands 5,467,000,000 barrels—*i.e.*, 48½ per cent of the estimated workable subterranean store created in far-off geological ages.

In the main, until the advent of the automobile, kerosene was the primary aim in the refining of petroleum, and wrought wonders in furnishing a cheap and brilliant illuminant—supplanting the older "coal oil" which had been distilled previously from certain bituminous deposits. With the advent of the self-propelled conveyance gasoline, so long a by-product in the manufacture of kerosene, acquired a new commercial significance; and now this liquid fuel is, in fact, the supporting backbone of the petroleum refining industry. From petroleum, when completely refined, we get four main products, *i.e.*, gasoline, kerosene, fuel oil, and

lubricants, and a number of secondary products such as benzine, vaseline, paraffin, road oil, asphalt, and petroleum coke. By recourse to "cracking processes" it is practicable to secure still higher percentages of the much-desired gasoline. The importance of this is brought home to us when we recall that we have quite 8,000,000 power-driven vehicles in service; and it is authoritatively declared that there will be double this number in use nine years hence. We are told that motor fuels represent a big percentage of petroleum consumption, and that they come next in volume to fuel oil.

Viewing frankly the situation that confronts us, and remembering the divers commodities that can be extracted from crude oil by the refinery, it is disturbing to learn that something like half of the petroleum produced in this country is burned under boilers for steam raising, thus sacrificing the more valuable main and secondary products. As has been well said, "The application of fuel oil to steam raising is an economic perversion." During 1921 our electric utilities alone consumed 12,603,728 barrels of fuel oil, the larger measure of which was used in the States of Texas and California. Fortunately, further increase of oil-burning locomotives is reported checked; and, in the long run, coal must be relied upon to meet the fuel requirements of stationary steam plants. This is inevitable so that the ships of our merchant marine and the navy may be supplied with fuel oil.



How our consumption of petroleum has climbed in the course of forty years

By reason of the special duties imposed upon the defensive fleet, and, on the other hand, the need of operating our ships of trade at the lowest practicable cost so that they can compete with the merchant craft of other nations, it is essential that the navy and the merchant marine be given preference in the utilization of crude or fuel oil. To this end, wherever feasible, both fighting and mercantile vessels should be equipped with engines of the so-called Diesel type. Much has been achieved in developing this order of internal combustion motor since its conception in 1893; and today the latest type of double-acting Diesel engine attains an efficiency four times that of the coal-fired steam engine and two and one-half times that of the triple-expansion oil-fired steam engine.

Less than five years ago the U. S. Bureau of Mines stated: "We are today using efficiently—*i.e.*, for gasoline and lubricating purposes—not more than 30 per cent of our oils. The other 70 per cent is used in competition with coal or exported to foreign countries and is generally sold for less than the cost of production." While the situation has improved, our petroleum resources still stand to be exhausted within 50 years.

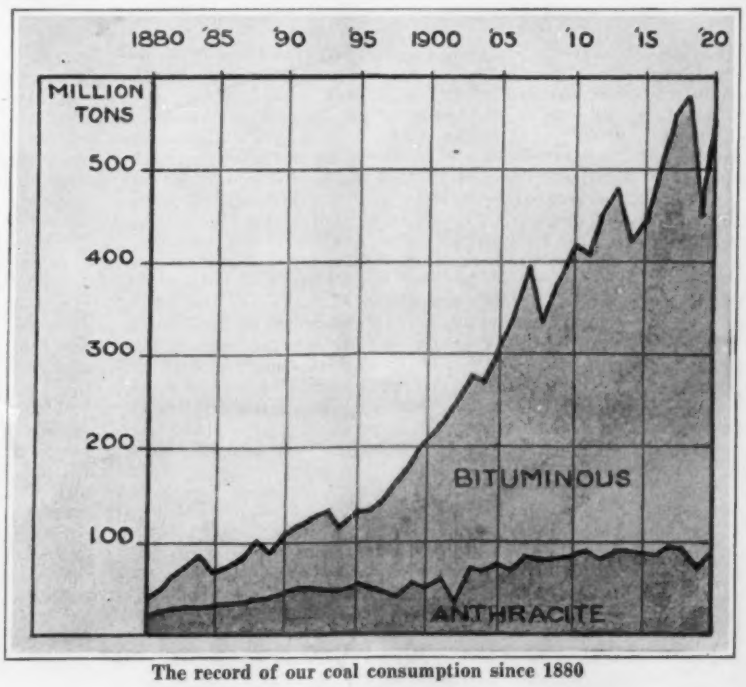
The average automobile requires in the course of a year more than ten barrels of gasoline. The net result of mechanical progress having done little toward reducing this unit consumption of gasoline, the present solution of the problem lies in meeting the growing demand by finding ways to manufacture still larger quantities of gasoline without correspondingly increasing the expenditure of crude petroleum.

Much has been done in this direction by greater recourse to cracking processes; and splendid results have been realized by the wider extraction of casing-head gasoline and recoveries of the liquid fuel from natural gas generally. During 1920 so-called "natural gasoline" was extracted from casing-head gas to the measure of 12,800,000 barrels. The cracking processes have not been developed to the possible maximum, and there are reasons to believe that through these agencies the yield from a given volume of petroleum might be considerably augmented. Undoubtedly more gasoline can be got from casing-head gas, but the percentage of gain is a matter of speculation, inasmuch as no one can foretell what gasoline content will be found hereafter in the gas rising from our oil wells.

Worthy of at least passing mention are the efforts to recover gasoline from uncondensed still vapors, to improve by means of fractionating towers the gasoline extraction from petroleum, and to save present evaporation losses during the period of storage on the lease. In the Mid-Continent field alone, this is the cause of an annual gasoline wastage of 122,000,000 gallons—this dissipation being equivalent to about 3 per cent of the gasoline produced in the United States in a year from all fields and all sources. This evaporation loss should be cut down notably by the use of efficient equipment.

Well over half a billion gallons of high-grade fuel oil are consumed annually in the manufacture of illuminating or artificial gas. The purpose of the oil is mainly to add hydrocarbons so as to increase the candlepower of the gas. The use of incandescent mantles and the adoption of a heat standard rather than one of luminosity would obviate the employment of this oil and yet make it possible to meet all of the requirements for lighting and cooking in the home. Incidentally, gas so prepared could be sold to the consumer at a correspondingly lower price.

Of natural gas we burn usefully in a twelvemonth fully 800,000,000,000 cubic feet—equivalent to the heating value of 40,000,000 tons of coal, and something like 8,000,000 families are directly benefited by it in cooking, heating, and lighting. But the most significant aspect of this matter is that approximately two-thirds of the gas is used industrially. The history of our treatment of natural gas is a record of wanton waste. Just think of it, in the course of one month gas was allowed to escape unchecked from a well yielding the while 1,000,696,000 cubic feet of the commodity; and in two months four wells scattered broadcast a total of more than 5,000,000,000 cubic feet of gas! This dissipation of potential heat corresponded to 250,000 tons of coal, or enough to supply 50,000 households for a year. By recourse to moderate expense for proper casing at our gasoline wells an enormous conservation of this fuel might be effected.



The record of our coal consumption since 1880

Before leaving the subject of our petroleum resources, let it be said that their potential exhaustion would not deprive us of a native reserve of liquid fuel. We have in our widely distributed oil shales a store many times more extensive than our original deposits of petroleum. The shales of Colorado alone are said to hold quite 20,000,000,000 barrels of oil, while those located in southwestern Indiana may possibly be made to produce 100,000,000,000 barrels. According to best authorities, a ton of Colorado–Utah shale would, by suitable extractive methods, give 50 gallons of oil; from 17 to 25 pounds of ammonium sulfate, so useful as a fertilizer; and 3000 cubic feet of gas. In Scotland the refining of oil shales has been pursued on a commercial scale for decades; and our problem is to profit by that experience and to develop processes suited to our own needs. The cost of shale oil will be higher than that of petroleum oil, but its recovery will inevitably become one of our great industries.

The time will surely come when we shall avail ourselves of our 2,000,000,000,000 tons of lignites; and already much has been done here through promising researches carried out by the U. S. Bureau of Mines. It has been shown conclusively that this fuel can be used to the best advantage by adopting a carbonizing process. The carbonized lignite can then be manufactured into briquets, while the by-products of carbonization represent values in the form of gas, ammonia, oils, and tar. The tars and oils can, in turn, be made to yield numerous worth-while chemicals.

In conclusion, let us touch briefly upon what we can do when our anthracite is gone. Our technicists have demonstrated, on a commercial scale, that we can have a plenty of smokeless fuel if we put our bituminous coal through the by-product coke oven. By this medium we may obtain the base of a so-called "artificial anthracite"; in other words, secure from each ton of soft coal 1500 pounds of smokeless fuel, 10,000 cubic feet of gas, 22 pounds of ammonium sulfate, 2½ gallons of benzol, and 9 gallons of tar. This is what is termed the high-temperature process; and the resultant coke usually contains only about 2 per cent of volatile matter, which renders it difficult to ignite or to control in the ordinary stove or furnace.

A more recent development is the low-temperature carbonization of coal. This treatment leaves in the coke from 8 to 15 per cent of volatile matter; the fuel ignites readily, burns without smoke, and is admirably suited for domestic use. As a by-product there is an oily tar double in quantity to that got by high-temperature carbonization. This tar can be made to yield goodly quantities of motor fuel, both burning and lubricating oils, and moderate amounts of pitch—not to mention liberal percentages of cresols and phenols. While there is less gas given off, it is of a higher caloric value than the gas realized by the high-temperature method. A ton of coal carbonized by the low-temperature process furnishes from thirteen hundred to fifteen hundred pounds of coke; from two thousand to seven thousand cubic feet of gas; from twenty to thirty gallons of tar, and from two to eight pounds of ammonium sulfate.

Alcohol is sure to play a conspicuous part in the motor fuels of the future; and the sources from which this can be obtained are numerous and extensive. Again, benzol can and is being garnered from gas houses and coke ovens; and combinations of alcohol and benzol have shown excellent qualities as motor fuels. While research has revealed that we may look forward undismayed and be sure of an abundance of fuels for all purposes, still we must not lose sight of the fact that most of the substitutes for those in common use will entail heavier costs and mechanical modifications before their general adoption. Such being the outlook, it behooves us to employ our present fuels more carefully.

Bridging the Detroit River

Suspension Bridge of 1803-Foot Span Will Connect Detroit With Canada

THE early years of the twentieth century will be spoken of in future histories of bridge construction as the era of the long-span bridge. It is true that the last two decades of the nineteenth century saw the construction of the Brooklyn suspension bridge and the Forth cantilever bridge. But the first two decades of the present century have witnessed the building of the longest truss bridge at Sciotoville, over the Ohio River; the longest cantilever bridge, over the Saint Lawrence, near Quebec; the longest arch bridge at Hellgate, over the East River; and of two additional suspension bridges of the first magnitude in the Manhattan and Williamsburg bridges across the East River. Furthermore, before the present century is 30 years old the colossal Hudson River bridge will have been opened for service.

Two other long-span bridges have recently been authorized, and doubtless in due course will be completed. One of these, with a span of 1750 feet, will span the Delaware between Camden and Philadelphia. A description of this large structure will be found in the issue of the SCIENTIFIC AMERICAN of July 2, 1921. And now the city of Detroit has determined to provide a great highway for railroad and vehicle traffic across the Detroit River, thereby linking itself with the Canadian shore. The necessary authority has been obtained from Congress and from the Dominion Parliament, and a charter has been granted to a joint American and Canadian company for the construction of the bridge. The plans which are herewith shown have been prepared by Charles E. Fowler, chief engineer, and Dr. D. B. Steinman, his chief assistant.

The principal characteristics of the bridge are as follows: The center span will measure 1803 feet from center to center of towers, and each shore span will be 925 feet in length from center of tower to face of the anchorage. The floor of the bridge between the towers will be suspended from eight cables, and between the towers and the anchorages it will be carried upon a series of steel piers. The height of the main towers from their bearing on the piers to the center of the upper cable will be 390 feet.

The traffic over the bridge will be accommodated on two decks. Upon the upper deck will be two 7-foot sidewalks and two 28-foot roadways, the total width over all of the highway deck being 97 feet. Upon the highway deck will be two trolley tracks, and on the lower deck will be four railway tracks, which will be arranged to carry electrically-operated trains. In the center of the lower deck will be an open space 20 feet wide for the accommodation of such public utilities as electric cables, gas mains, water mains, et cetera. The depth of the stiffening truss is 50 feet.

An interesting feature in connection with this great structure is the provision which has been made for building first, as many of the cables and such of the steel work as are necessary to carry merely the highway and electric car traffic. Subsequently, when arrangements are completed for full railroad service across the bridge, additional cables will be built and the floor and the stiffening trusses will be strengthened by the addition of the steel which will be necessary for that purpose.

By referring to the drawing showing a cross section of the floor system it can be seen that eight cables are provided, and that they are of different sizes. Six of these are 21 inches in diameter and two are 18 inches. At the center of the bridge four of the 21-inch cables are a few feet above the level of the upper deck, and the two 18-inch cables and two 21-inch cables are several feet above the level of the lower deck. Also it should be noted that these four last-named cables have a deeper dip or sag than the upper floor, as will be noticed in our skeleton elevation of the bridge. Where the cables pass over the towers the four upper cables are attached above and independently of the lower cables.

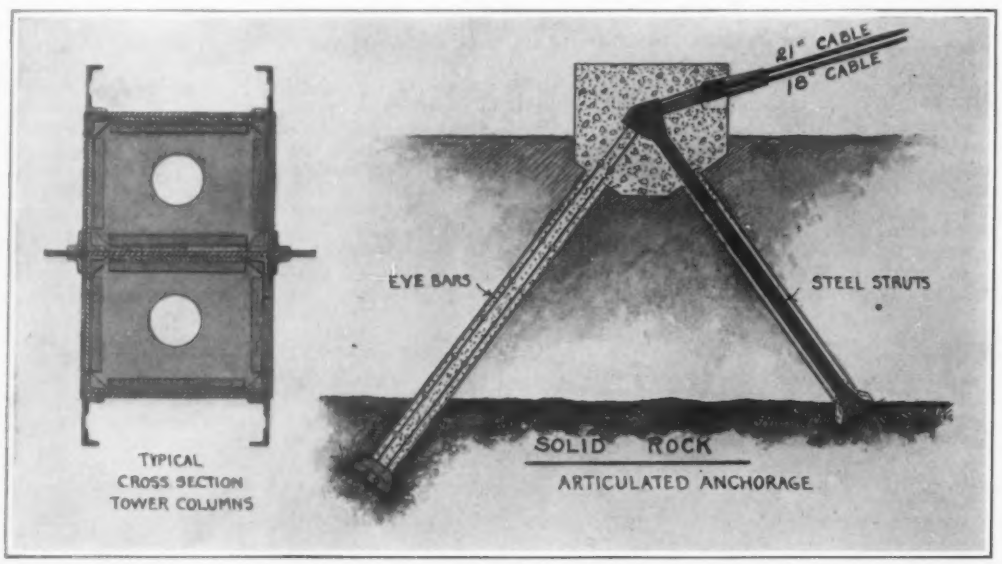
Now, it will readily be understood that the loading of the lower deck, with its four lines of railroad trains, engines, et cetera, is far heavier than that of the upper deck. Consequently, in constructing the bridge to carry only the lighter load of the highway and trolley traffic, it will be sufficient to string only two 18-inch and two 21-inch cables, the other four being omitted. Furthermore, the stiffening truss, as built to carry only the highway traffic, will be very much lighter both in its top and bottom chords and in the diagonal web bracing. By referring to the diagram showing one of the trusses and a chord section, it will be seen how the problem has been worked out. The full lines in the truss diagram represent the material that will be built into the truss for carrying highway traffic, and in the chord section only those portions which are shown shaded will be built. Later, when the four additional cables are added, the trusses will be strengthened by inserting the diagonals which are shown dotted in the diagram and by adding the plates and angles which are shown unshaded in the drawing of a chord section.

The steel towers consist each of four posts which are placed in the same vertical planes as the four pairs of cables, there being, it will be understood, one pair of cables to each of the four stiffening trusses.

Attention will be directed to the method of stiffening the four legs of the tower against lateral distortion, by the free use of arched portals. This is a new departure for a large bridge of this kind. Usually such bracing has consisted of the conventional struts and ties, as in the case of the towers of the Manhattan suspension bridge. The portal system is used in the three upper tiers of panels and at the base of the towers. The space between the level of the floor of the bridge and the lower portal bracing will consist of solid plate-steel diaphragms. Each leg of the tower measures in cross section from 10 feet to 17 feet out to out, and has a uniform width of six feet. An interesting feature is the footing of the towers upon the foundations. Instead of flaring out the bases of the towers and bolting them down rigidly to the foundations, as was done in the Manhattan bridge, the footings are struck to a curve whose radius is the distance from the bearing to the center of the stiffening trusses. This convex curved footing rests upon a concentric concave bearing on the steel foundation, and is provided with rollers. The result is that as the top of the tower is pulled out of the vertical by the effects of temperature, the whole tower rocks about the trusses as a center. This means that the towers are subject only to compressive loads and are free from those heavy bending stresses which occur in a tower bolted down, as are those of the Manhattan bridge. How great is the economy of materials secured by using a rocker bearing will be understood from the fact that if these tower posts were bolted to the foundations they would have to contain twice the amount of steel in order to take care of the enormous resulting bending stresses. The maximum compressive load on either of the inner tower posts is 30,500,000 pounds under working live-load and under extreme conditions of temperature and wind pressure. The weight of the towers is about 20 million pounds.

The back stays, it will be noticed, are unloaded; that is to say, the weight of the shore spans is not transferred to the cables by suspenders. Instead of this the load is carried upon four steel piers. Artistically, it is to be regretted that the shore spans are not cable-supported; but we understand that the use of suspenders was impossible because of a curve in the railway approach. Also the engineers wished to avoid large deflections in the side spans and decrease the main span deflections.

Another radical departure from accepted practice in large suspension bridges is found in the cable anchorages. Usually such anchorages consist of a large mass of masonry whose frictional resistance to sliding is sufficient to hold the cables taut. In the Detroit River bridge Mr. Fowler decided to transfer the pull of the cables directly to the underlying rock, thus dispensing with the usual massive anchorage. The cables, it will be seen, are attached to a steel bearing at the top of an inclined steel strut, which is carried down to a footing upon solid rock. The pull of the cables is transferred by a series of eye-bars down to an anchorage plate which is set deep within the underlying rock. All of these eye-bars are two inches thick by 16 inches deep. For the 21-inch cables there are alternately 30 and 31 eye-bars; and for the 18-inch cables there are alternately 21 and 22 eye-bars. Transversely to the axis of the bridge at the point where the cables, eye-bars and struts meet, there is formed a massive concrete block 130 feet in length, and of the cross-sectional form shown in our drawing. This anchorage block serves to tie the four strut frames together; but no reliance is placed upon it for resisting the pull of the cables. Both the struts and the anchor chains are enclosed in shafts of concrete, which thoroughly protect them from corrosion and to a certain extent act as a reinforcement of the anchorage.



The articulated anchorage carried down to rock which will take the place of the usual massive masonry anchorage

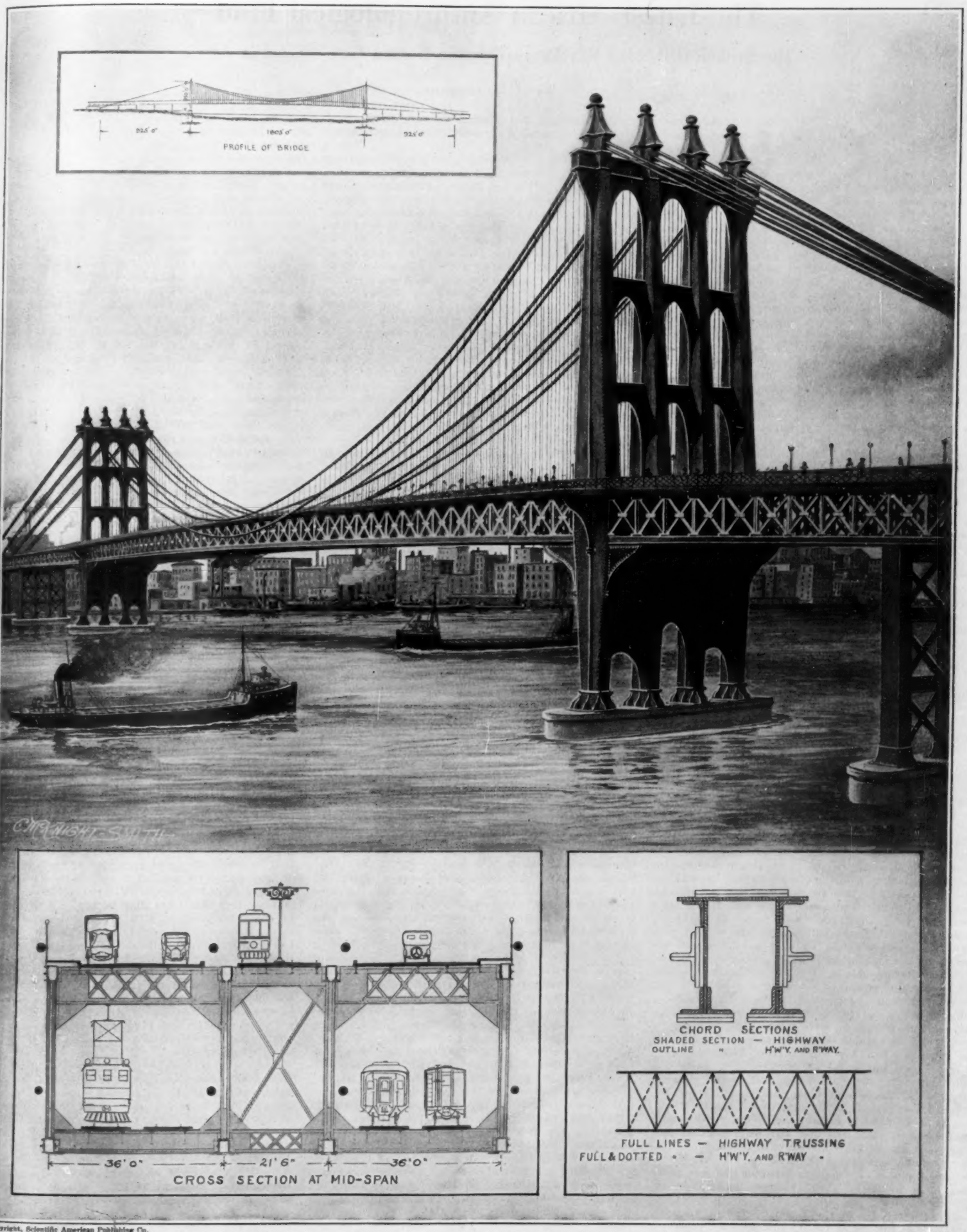
Gears of a New Material in Place of Steel

WORM wheels or gears of a new material is a recent development. Such wheels have mainly been made of steel or iron or bronze, but now, for certain purposes and under certain conditions, they are being made of duralumin. This alloy, while not used recently, has never before been used as gears. Duralumin is an alloy of aluminum, magnesium, manganese and a little copper, and its strength and toughness can be made equal to mild steel and for a given section the weight is one-third that of the continental bronze. Superior strength in the teeth is assured by its alloy's tensile strength and elastic limit.

The same properties that make duralumin a suitable and desirable material for worm wheels also make it valuable for spur gears and other gearing. It is suitable as worm wheels where the pressures are sufficiently within the elastic limit of 30,000 pounds where this addition is net, it replaces iron, steel, brass, etc.

Where duralumin can be run with steel rather than against itself the best results are obtained. For example, in the tinning gear trains of automobile motors where both long life and quietness are essential. Helical cut spur gears of duralumin alternated with steel gears have been in successful service.

Duralumin gears when used with steel gears are quiet, which seems about paradoxical since all duralumin forgings, when struck a blow, are resonant. This is probably explained by the difference in pitch and the sound vibrations of steel and duralumin, but only true when the mass and section of the duralumin gear are properly proportioned to the steel gear.

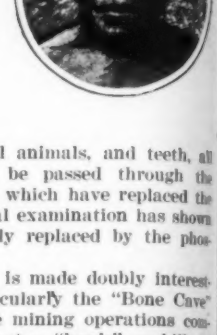


THE PROPOSED SUSPENSION BRIDGE ACROSS THE DETROIT RIVER, WHICH WILL PROVIDE AN INTERNATIONAL RAILROAD AND HIGHWAY BRIDGE BETWEEN THE UNITED STATES AND CANADA. MAIN SPAN, 1803 FEET. CAPACITY: UPPER DECK, TWO SIDEWALKS; TWO 28-FOOT ROADWAYS; TWO TROLLEY TRACKS; LOWER DECK, FOUR RAILROAD TRACKS

The Latest African Anthropological Find

The Broken Hill Skull May Prove That the Human Race Started in Africa

By A. A. Hopkins



AN ancient skull has recently been found at the Broken Hill Mine in Northern Rhodesia in a bone cave some 140 feet below the original top of the hill and near to the whirling wire cables of the mine. The bone cave was already famous for its stalactites and stalagmites. The skull was found at the farther end of the cave by a New Zealand engineer, whose trained eye immediately recognized the importance of the find. Unfortunately the laborers are not archaeologists, so we have to chronicle the loss of the major part of the skeleton, but a leg bone, the collar bone, portion of the shoulder blade, part of the lower jaw and other fragments which have enabled the experts of the British Museum to arrive at very definite conclusions. It is, of course, perhaps premature to say that this is the oldest known human remains extant, but it seems assured that it is more ancient than the Neanderthal man, and it opens up the question as to whether the human race may not have originated in Africa and migrated to Europe before there was any Mediterranean. The best presentation so far of the find is in *The Illustrated London News*, and we are indebted to that journal for advance pictures and information. *Nature* and *Discovery* have also added their quota of information.

The brain-case is of modern human type, and the bone not thicker than that of the ordinary European, says Dr. Woodward; the capacity, though not yet accurately determined, is clearly above the lower human limit. The orbits are large and square, with pronounced overhanging ridges much extended laterally. The forward position of the foramen magnum indicates that the skull was poised on an upright trunk. The palate is large, but typically human, and adapted to perfect speech. It is remarkable that the teeth are much affected by caries. The lower jaw must have been massive and larger than the Heidelberg jaw. The appearance of flatness of the frontal area suggests a comparison with Pithecanthropus erectus. Dr. A. Smith Woodard was inclined to find the nearest approach to the Rhodesian skull in the Neanderthal type from La Chapelle aux Saints in France. Though markedly modern in regard to the brain-case, in its facial characters, while it is essentially human, it appears to hold a position between the gorilla and Neanderthal man. Fragments of the long bones, both femur and tibia, which have been found indicate that, unlike Neanderthal man, Rhodesian man walked in a perfectly upright posture. Dr. A. Smith Woodward regarded Rhodesian man as possibly a later development than Neanderthal man, but Prof. Elliot Smith suggested that he might represent a primitive type of which Neanderthal man might be a highly specialized form.

Thirty years ago the most ancient human remains that had been excavated were those of the Neanderthal men, found in various parts of Europe. But in 1894 the remains of a far earlier type, Pithecanthropus erectus, were unearthed in Java by Dr. Dubois, a Dutchman: and these were assigned to the Pliocene Age, whereas the Neanderthals probably existed in the Middle Pleistocene or last Glacial Age. Dubois' "find" was, in fact, hailed in certain quarters as the "missing link" between man and ape, but most prehistorians have since agreed that this belief is impossible. Further examinations of the Rhodesian skull have yet to be made, but it is very doubtful whether they will prove its priority in age of the Java remains of Pithecanthropus erectus.

Sir Arthur Keith of the Royal College of Surgeons says: "The Rhodesian fossil skull does not represent a type of man which is new to anthropologists; every feature of this skull proclaims the ancient African of whom it formed part to have been first cousin to Neanderthal man, that peculiar species of humanity which lived in Europe throughout a certain phase of the Ice Age.

"It can not be said that this discovery of fossil man has taken the anthropological world by surprise. From time to time during the last 50 years numerous travelers and local archæologists have reported the find of Palæolithic stone implements in South Africa, in workmanship not unlike the implements found in the gravel and terrace deposits of Europe. The presence of such flint implements is a sure indication that man is an ancient inhabitant of South Africa. Then, again, an ancient skull, far beyond the modern average in the size of its brain cavity, was unearthed at Boskop, in the Transvaal, just before the war. Although this skull is modern in its chief features, and certainly Negroid in its affinities, yet it differs in important details from all known skulls. Then, again, in South Africa we find the most aberrant of all living human types—the Hottentot, and the pygmy or dwarf race, related to the Hottentot—the Bushman. No one who had noted all these circumstances can have been surprised by the discovery now made. We may hope that Africa will yield many ancient documents relating to the prehistory of human races.

"Can anything definte be said regarding the date at which the Neanderthal type or species of man flourished in Europe or Africa? Professor Marcellin Boule, the leading authority on this matter, assigns Neanderthal man in Europe to the period which saw the last great extension southward of the ice-sheet. In England the opinion which finds acceptance at the present time places this phase of the Ice Age between thirty and fifty thousand years ago. As regards the Northern Rhodesian man, the date does not appear to be so remote. Dr. A. Smith Woodward has observed that the remains of the animals which are found in the same subterranean channel as this remarkable human skull are not those of extinct species, but are remains of species now living in Africa. In Europe the remains of Neanderthal man are found with those of species which have become extinct or ceased to live in Europe. In Europe Neanderthal man seems to have appeared suddenly, and, after holding sway for a long period, to have as suddenly disappeared, being replaced by Europeans of a modern type. As to where and when mankind of the modern type was evolved, the present discovery throws no light, but it does open out and illuminate the ancient world of that very remarkable species of humanity—Neanderthal man."

The question of the "Bone Cave" is particularly interesting. The mine is at present an open quarry, and the "Bone Cave" has been famous among geologists for a number of years. It was at the foot of this "Bone Cave" that the skull and other human bones mentioned were found, constituting the only human remains out of the many hundreds of tons of bones that have been removed during mining operations. Fossilized and partly fossilized remains of elephant, lion, leopard, rhino, and hippo, also of antelope and other cattle, together with tons upon tons of bones of small animals and birds, have been found. Mr. Harris has stood at a place where this "Bone Cave" has been cut through and has pulled out from the debris various fossilized bones, such as jaw bones, skulls of small animals, and teeth, all of which were destined to be passed through the smelters to obtain the metals which have replaced the lime of the bones: for chemical examination has shown that the lime has been largely replaced by the phosphates of zinc and lead.

The discovery of this skull is made doubly interesting when the mine, and particularly the "Bone Cave" itself, are considered. Before mining operations commenced there stood at this spot a "kopje" or hill, 50 to 60 feet high, with a slight depression in the center. Mining operations have demolished this hill, and have excavated to the depth of over 90 feet below ground level where the hill stood, and it was at this depth that the skull was discovered. The entrance to the "Bone Cave" was at ground level. One of the early prospectors, who visited it before mining operations had commenced, has described the cave as having been practically filled with debris. After one had crawled over this obstruction and stood upon the floor of the cave proper, it could be seen that bones of various animals were scattered all around. The floor was made of loose debris and fairly dry. The walls and roof were studded with crystalline deposits which, when lighted up with the rays of a candle or lamp, reflected back the light, making a veritable fairy cavern, while bats and owls, disturbed by the unaccustomed lights, flew round, much to the visitors' discomfort.

"How did these bones get into this cave and how long have they been accumulating?" says Mr. W. E. Harris. "How did the skull and other bones of the skeleton, the only human remains found there, come to be at the toe of this cave, with tons upon tons of bones above them?"

"One prominent geologist has suggested that the bones have been placed in the cave by human agency. In amplification, another suggestion has been that the original cavern may have been an extremely ancient mine-shaft, which was later used as a dumping pit for animal refuse by a tribe of hunters. But the obviously great antiquity of the skull would discountenance the mining theory, while the enormous quantity (some hundreds of tons) of animal bones, and the fact that more than 90 per cent of them are so small that the animals must have been far too little to serve as food for human beings, rather tends to cast doubt on the dumping theory. The theory that these animals were engulfed while taking refuge from some natural upheaval, such as fire or flood, is likewise untenable, inasmuch as at the toe, where the skull was discovered, apart from the skull only small bones have been found. The larger bones were deposited nearer the mouth, and from their condition must have been a far more recent deposit than that of the skull or surrounding bones."

The Rhodesian skull after cleaning. A human skull with reminiscences of an ape-like ancestor

Under side of Rhodesian skull. A typically human palate adapted to perfect speech. Photograph taken after cleaning

Our cover is from a painting by Mr. Howard V. Brown and shows an episode in the daily life of this early cave man. He is coming out of his primitive abode to match his human wit with the brute strength of a woolly-haired rhinoceros of the period. This illustration, as far as the reconstruction of the Rhodesian man is concerned, is taken from the drawing in the *Illustrated London News* from details supplied by Dr. A. Smith Woodward, the distinguished Keeper of the Geological Department at the South Kensington Museum, in whose charge the Broken Hill skull has been placed. As far as the data goes, we are not able to connect the Rhodesian man with hairy animals of the North, but we have no proof that men of this period did not roam in the North where they would readily have come into conflict with such early fauna.

Artificial Cork

Waste Materials Used in Its Manufacture, and the Applications Found for It

By Ismar Ginsberg

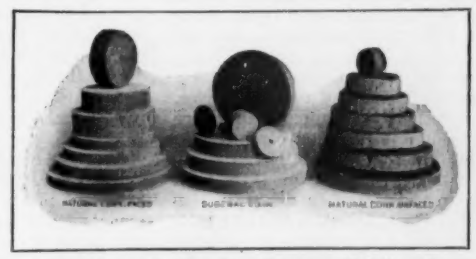
DURING the past few years there have been a number of important developments made in the artificial cork industry. Thus in Austria there has been patented a process for making an artificial product from cork dust (see German Patent No. 278036). The greater part of the cork dust or cork granules is cooked first in water or a weak alkali or a water glass solution, and then allowed to remain in contact with the liquid for a period of time, varying from 24 to 48 hours. The object of this treatment is to secure a very thorough opening up of the pores of the cork. The smaller portion of the cork granules, in the meantime, is treated with a caustic soda solution and then with carbon disulfide. In this way a thick viscous solution is obtained. This mass is then mixed with the water-treated part of the cork dust, and a small amount of cork meal is also added. The entire mixture is incorporated very thoroughly with the aid of a blast of air. After the colloidal cellulose has separated from the viscous mass, the mixture is pressed in molds. There may also be added to the mixture small quantities of glue, water glass, rosin, casein and other similar agglutinants, and furthermore such fillers as saw-dust, wood flour, ground-up peat, a powder made from pulverizing leaves and foliage, asbestos and many other materials of like nature.

Slipper insoles which are being freely made of artificial cork

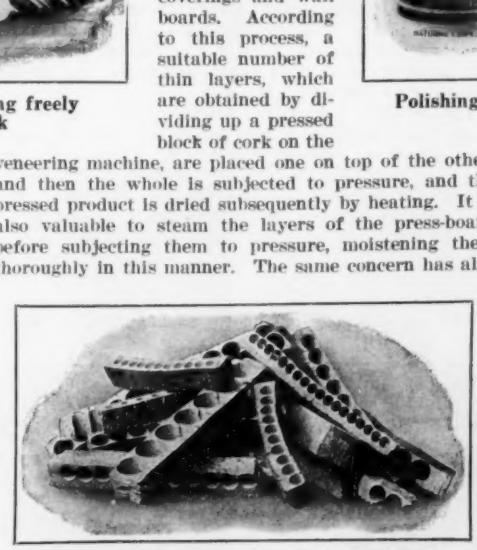
A very good product is obtained when ten kilograms of the cork meal is cooked with water and allowed to remain in the aqueous medium for 24 hours. While this is happening, five kilograms of the meal are mixed very thoroughly with one and one-half kilograms of a caustic soda lye (containing one part of caustic soda solution, 38 degrees Be., to two parts of water), and the mixture is permitted to remain for several days in a closed vessel in a cool spot. Then four hundred grams of carbon disulfide are added, and the mixture is again allowed to stand for two more days. After this time has elapsed the cooked cork dust is mixed with two kilograms of dry meal and the five kilograms of the viscid material and the whole mass is vigorously agitated by a current of air, so as to give a homogeneous mixture. After a little glue and water glass solution have been added, the mass is pressed into sheets in the cold at 200 to 250 atmospheres pressure. Then the sheets of cork are air-dried by subsequent pressing in a hot press at 100 atmospheres pressure. One use to which these sheets of pressed cork are put is in making various sorts of floor coverings.

Another method, the Raschig Process, was patented by a concern in Mannheim (see German Patent No. 317945). The mixture of cork dust and binding agent is made in the usual manner, and pressed sheets are formed therefrom by means of pressure. The sheets of pressed cork in special molds are placed in an apparatus where they are subjected to a temperature of 70 degrees Centigrade under as high a vacuum as can be obtained. The proportion of agglutinate is at a maximum 10 per cent of the quantity of cork dust used in the mixture. After a thorough mixture has been attained, the mass is placed in molds, whose walls are pierced with holes, and subjected to a pressure of one kilogram per square centimeter. Then the pressed sheets, just the way they are, are placed in a cast iron container which is furnished with steam coils and from which the air is exhausted as completely as possible. The sheets remain in this apparatus for 30 hours without heating; then the temperature is raised to 30 degrees Centigrade. After this has been maintained for about 10 hours then the temperature is raised to 45 degrees, and 5 degrees more each 10 hours. After five to six days a temperature of 70 to 80 degrees has been attained. The sheet of pressed cork is completely dried in this fashion, and a section cut through it has the appearance of natural cork. It is light in color and is very well suited for the manufacture of corks.

Another German concern has a process for making cork sheets by the use of a veneering machine. This process is covered by German Patent No. 288319. The products are well suited for making floor coverings and wall boards. According to this process, a suitable number of thin layers, which are obtained by dividing up a pressed block of cork on the veneering machine, are placed one on top of the other, and then the whole is subjected to pressure, and the pressed product is dried subsequently by heating. It is also valuable to steam the layers of the press-board before subjecting them to pressure, moistening them thoroughly in this manner. The same concern has also made cork articles from cork dust by heating and pressing. It was found best to expose the cork, during the heating process, by means of an ingenuous machine in a loose uniform layer in the absence of air. (See German Patent No. 285101.)



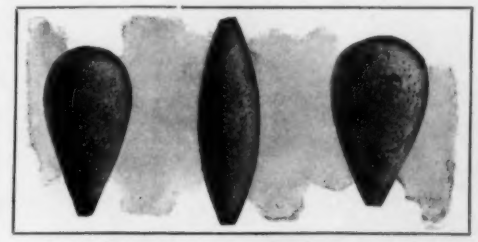
Polishing wheels of cork or artificial cork used on glassware



Cork punchings; the refuse left after bottle corks are cut from a sheet of true cork. This is a source for the conglomerated product here described

The proprietors of German Patent No. 294072 have been very successful in obtaining well made molded cork articles from cork dust by the use of heat alone. According to this process, the pieces of cork which are to be worked up into various articles are coated with a fire-resistant material, such as water glass, sulfate of alumina, lime or a mixture of these, and then heated. Another way of working is to make the article first and then coat it with the fire-resistant paint and finally heat it to 200 degrees Centigrade. The products that are obtained in this manner are solid and resistant to wear and tear.

Washers and gaskets of cork, used by the millions under metal bottle-caps and in lubricator cups. They are equally effective when made of cork composition



Artificial cork is of course as good as the original product for bobs and floats

Another method of making cork composition is to mix the powdered or granulated cork with china wood oil, form the article in a mold and then heat it to a temperature of 212 to 220 degrees Fahrenheit.

An artificial cork is made from a mixture which consists of 48 parts by weight of granulated cork, 28 parts by weight of defibrinated blood, one part by weight of turpentine and 12 parts by weight of glycerine. The mixture is made with the idea of using the cork in the hot condition. The mixture is heated and pressed into the desired form. Stoppers for bottles have been made very successfully in this manner.

C. Lindemann patented a process (see German Patent No. 318745), in which cork stoppers are made from agaric, which is rendered resistant to moisture, acid and the drying action of the air. This is accomplished by dipping the cork, speared on a fine needle, into a bath of melted paraffine. It may be said that agaric is a name given to a tree fungus which is used as tinder. More widely it is employed to indicate a variety of corky forms that grow on trees in various parts of Europe. It is in this extended sense that it is used here.

Artificial cork is further made from various plant fibers such as straw reeds, wood and sprouts which are easily worked up. These materials are ground up finely and then the powder is subjected to a steam pressure of from 3 to 4 atmospheres in a closed vessel, until all the water soluble or those constituents, which first are converted into this form, are removed. Then the residue is incorporated very thoroughly with an emulsion made from soap and low melting point hydrocarbons such as bitumen. The soap is then converted into the insoluble form by cooking with lime-water or any other suitable salt. The mass that is obtained in this manner may be formed into any desirable shape, then dried at about a temperature of 130 degrees Centigrade.

Wireless Telephone Progress

WIRELESS telephony has of late shown extraordinary developments. We have not only succeeded in simplifying the apparatus and sharpening the tuning, but also chiefly in transmitting over larger distances. Thus, for instance, it is today possible to speak from Paris to Basle or Moscow and at that quite clearly. Even musical pieces and operas have been 'phoned across space by wireless. Trials that have lately been made in this direction have had such brilliant results that one may actually speak of a new era having started for wireless telephony. The operas "Madam Butterfly" and "Aida" sent out by the transmitting station were heard most distinctly at all stations put up around at a large distance; and like results have been attained in the transmission of musical pieces in America. As receiving apparatus has already been greatly simplified so that the costs of production have become comparatively low it has been decided to bring them now into general use. A large wireless telephone company will probably start ready by the first of the year with the lending of receiving apparatus to people desiring such. A gigantic transmission station will in future get up concerts and many thousands of persons hundreds of miles distant will be able to listen to them. Not only musical pieces will be transmitted, but also sermons, speeches in Parliament, exchange reports, etc., and everyone possessing a wireless receiver need only take up the telephone receiver and listen. The musical pieces, reports, lectures, etc., will all be sent from the transmitting station at the same time. They are, of course, unintelligible to the unaided human ear even in the station itself, for the sounds are transformed into rapid motions of the ether which are not perceptible to us. All these oscillations of the various communications have different wave-lengths so that they can not disturb one another. It is left to the choice of the listener whether he wants to hear a sermon, a concert or an exchange report. Thus speaks one of our contemporaries in describing British radio progress.

Untangling Our Traffic Tangles

A Survey of What Modern Vehicular Traffic Means and How It Can Best Be Handled

By Dr. John A. Harriss

Special Deputy Police Commissioner, New York

THE widespread introduction of motor vehicles has done much for highway transportation. In fact, the railroads, with their great carrying capacity and their speed, displaced the highways to a great extent up till the advent of the motor vehicle. But with the steady development of the automobile and the motor truck, the highways have slowly but surely come into their own again, and today highway transportation is a powerful rival of the railroads of this country.

But the story does not run quite so smooth as I have put it. With the ever-increasing use of motor vehicles, the highways of the nation have become more and more taxed until now there is an overcrowded condition on many of our highway systems. This condition is really acute in large centers of population, such as New York and its surrounding cities and suburban districts. Indeed, no one can deny that the automobile brought back the highways into favor; and now there is no denying the fact that the highways must be developed to take care of the ever-increasing traffic if the automobile is to forge ahead.

A fair idea of the increased number of vehicles to be found on the public highways of the nation may be had when it is considered that during the *entire year* 1920, licenses were issued by the New York State Automobile Bureau for 52,128 commercial vehicles, as against 52,658 similar licenses for the *first six months* of the year 1921. In addition, there has been an increase of approximately 15,000 vehicles of all descriptions licensed by New York City, for which I can best speak, during a comparative five-year period.

It goes without saying that such an increase of street traffic in large cities like New York has called for rigid and effective traffic regulation. In the case of New York's Fifth Avenue, which handles more vehicular traffic, perhaps, than any other thoroughfare in the world, we evolved a signal system of traffic regulation. This system, which has attracted considerable attention, was not undertaken until the entire traffic problem had received prolonged and deep study, with special reference to congested conditions on Fifth Avenue which were so intense as to make anything like a ready and expeditious movement of traffic quite impossible.

From personal observation in the vicinity of one of the city's heaviest traffic points, namely, Fifth Avenue and 42nd Street, it was found that the ordinary method of handling traffic through the assignment of policemen at street intersections, even when aided by the "Stop" and "Go" semaphores, was quite insufficient to cope with the abnormal traffic conditions existing. Something really radical had to be done in order to handle the situation. And little help or suggestion could be counted upon from other municipalities, for nowhere was there to be found an equally difficult problem. After considering various ways of affording relief, including the establishing of a one-way regulation at certain times of the day, it was decided to try out a plan of signalling, similar to that in use on the railroads throughout the country, whereby uniform and simultaneous movement of traffic could be accomplished.

The decision soon took shape when signal towers were erected at 57th, 50th, 42nd, 38th, and 34th streets, for the control of traffic on Fifth Avenue and on cross streets, in the most congested area between 30th and 60th streets. These signal towers make use of signalling lamps by means of flashes, telephones and push-button signals, and serve to issue the orders to the traffic officers assigned at these points and along the avenue from 14th to 110th Streets.

The present towers are temporary structures, intended only to try out this innovation and, if necessary, work out certain refinements. Ultimately, new and ornate traffic towers will be erected, the design already having been selected. The present tower floor is 12 feet above the roadway, affording a clear view for the occupants. The base of each tower is designed in such a manner as to sheer off passing vehicles, thus furnishing, in addition to their specific purpose, "Isles of Safety" for pedestrians crossing the Avenue.

The signals flashed from the traffic towers indicate the following orders to traffic policemen at various street intersections, pedestrians, and drivers alike:

Yellow Light: Traffic moves on Fifth Avenue, while all cross traffic from side streets stops behind the building lines, or white limit lines when these are marked on the roadway.

Red Light: Traffic on Fifth Avenue and side streets stops behind the building lines, or white limit lines when marked on the roadway, so as to give clear intersections.

Green Light: Traffic from side streets proceeds.

The signals are in operation from 8 A. M. to 12 P. M. and serve to regulate not only the movement of vehicular traffic, but also apply to pedestrians in crossing the roadways, which they are required to do at the crossings.

And what does this all mean? Simply this: that whereas under the old system the traffic on the Avenue and side streets was handled by a large number of policemen stationed at the various intersections, each policeman handling his particular intersection according to his own judgment, so that the entire traffic flow was a many sided affair which got in its own way, so to speak, under the present traffic-tower arrangement the entire traffic stream is controlled as a single unit. Traffic on the Avenue starts as a unit, moves for a certain length of time, and is then stopped, giving an opportunity for traffic on the side streets, which has accumulated while traffic was moving on the Avenue, to cross the Avenue at the various intersections. This unison of all traffic movements is virtually clocklike—and certainly efficient. Indeed, by actual test under old conditions it was found that a vehicle required as long as 40 minutes to proceed on Fifth Avenue from 57th Street to 34th Street, or in the reverse direction—a mere matter of a mile or so—at certain times of the day. Under the new traffic regulation, however, this annoying and costly delay has been reduced by more than 60 per cent. The system has been successful beyond a doubt and has accomplished much in the way of eliminating annoying and costly delay.

Our present scheme, though, is by no means perfect. Here and there are little rough spots, so to speak, that will have to be smoothed over. For instance, it is believed that some improvement can be effected in the flashlight signal system by keeping the towers under automatic control as well as the individual control to

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Left: Fifth Avenue looking north from 42nd Street on a day when there was no especially heavy automobile traffic. *Right:* A nasty jam where the New York Central's freight artery into the city crosses Manhattan Street outside the ferry gates. A train has just cleared the crossing: the automobiles are going from the ferry and the pedestrians are rushing for seats on the boat. *Above:* One-way traffic on Williamsburg Bridge, over the East River

Typical traffic conditions in Greater New York. Pictorial proof of the serious traffic problem of today

which the experiment has so far been confined.

Another innovation which we have tried out with decided success in New York City is the one-way street restriction. It permits of a greater volume of traffic in a given thoroughfare than would be possible if the same thoroughfare were open to traffic moving in opposite directions. Usually where a regulation of this kind is adopted a similar one for the movement of traffic in the opposite direction is made effective on an immediately adjacent street, to avoid the possibility of inconvenience.

To increase the capacity of the East River bridges—the connecting links between New York City proper and Brooklyn and Long Island City—roadways for light vehicular traffic are in the course of construction above the main roadways of the Manhattan and Williamsburg Bridges, where bridge traffic is heaviest, and when these are ready for use the traffic capacity of these structures will have been considerably increased. In addition to this the approach to the Manhattan Bridge at the New York terminal is to be enlarged and widened, which will relieve congestion and permit of a more rapid movement of traffic in entering and leaving the bridge.

The ferry situation always presents a difficult problem in these days of heavy vehicular traffic. And nowhere is this problem more serious and difficult of solution than New York City proper, which is separated from the New Jersey mainland, to the west, by the wide Hudson River. With the different ferryboats crowded to capacity and operating on a fair schedule there still exists the problem of expediting the movement of numerous vehicles which suffer great loss of time in crossing ferries operating from the several boroughs comprising the city of New York. On Sundays especially, the ferries are badly congested. It is no unusual sight to see a line of automobiles a half mile long in front of a ferry terminal, waiting to board a boat. It is no uncommon experience for motorists to wait over an hour in such a line. Of course, a bridge would be the obvious solution, and a Hudson River bridge capable of handling a large part of the present ferry traffic between New York and New Jersey is a future probability. Larger ferryboats are also a probability, but over the short courses involved there would be little gained through the use of larger ferry units, so it seems. But the one source of early relief may be found in the vehicular tunnel now building between New York City and Jersey City. The New York outlet of this tunnel will be at the corner of Canal Street and the Varick Street extension, which has already become one of the principal arteries of traffic on the west side of the city.

Waiting for the Manhattan Street ferry on a Sunday morning during the pleasant weather. Coming back at night it is even worse on the Jersey side; the line may extend for a mile, and sometimes the jam is so bad that many drivers abandon their cars and return for them the next day

Parking is another consideration in the study of traffic in large cities. Under the present regulations in force in New York City a vehicle is permitted to park for such length of time as does not interfere with or obstruct the ready flow of traffic. In the highly congested sections of the city a maximum period of fifteen minutes is allowed, while in various parts of the several boroughs public parking spaces have been provided on extremely wide thoroughfares or open squares, where a vehicle may be parked for an extended period of time. Satisfactory results are being obtained under the present parking regulations, which, as a whole, have met with public approval.

The traffic problem is not altogether an urban one. Even on the remote rural roads traffic has become exceedingly heavy. Many of the principal country roads leading out of New York City are in poor condition and insufficiently wide to accommodate the volume of traffic passing over them. It seems to me that this condition could be relieved, without any large expenditures, if the State Highways Department widened these roadways so as to make it possible for four lines of vehicles to be operated over them at one time.

American Telephone Practice from a British Point of View

THE essential features of present American practice in telephone-line construction were described by Mr. E. S. Byng in a paper read before the Institution of Electrical Engineers.

After outlining the staff organization adopted by the American Telephone and Telegraph Company, constituting with its associated and connecting companies what is commonly known as the Bell System, and controlling some 12,000,000 telephone stations, he referred to the methods followed in making development studies with the object of forecasting the needs of many years ahead. In the next section of the paper he discussed the design and lay-out of plant, and noted among other things that, means having been found of eliminating the defects that were liable to occur in aerial cable, it is now settled policy, where local conditions permit, to run all long-distance cables aerially. In general it is claimed that the stability of an aerial cable route is assured by the precautions taken during installation, the chief points to be observed in planning such a route being short spans, extra short poles, removal of trees immediately adjacent to the route, suspension strand at correct tension, the right class of ring at short equal distances apart, marline ties to prevent crystallization and ring cuts, and grade clamps to avoid creeping.

In the section on engineering and constructional methods he dealt with pole routes, aerial cables, conduit routes, underground cables, cabling in hotels and large office buildings, block cabling and wiring, and drop wiring, and, after alluding to the extensive use made of motor vehicles for the transport of materials and men, gave an account of some of the mechanical and labor-saving devices employed. Among these are ditching machines for excavating the shallow trench required for telephone conduits; back-fillers, a modified form of farmer's plow, used for pushing the ground back into the trench before ramming; tamping machines, which will do as much work as 10 men each armed with 10-pound rammers or punners; pole-hole excavators, and pole erectors.

A pole-hole excavator consists of a three-ton truck carrying a large auger rotated at 60 r.p.m. by the engine through gearing and capable of making a hole 18 to 24 inches in diameter up to 8 feet deep. A revolving turntable on the truck enables the hole to be excavated from either side or from the rear of the truck. A pole-hole 6 feet deep can be excavated in from three to five minutes in various types of soil. Clay and even hardpan offer little resistance to the auger, the only serious obstacle being hard rock. In a more recent type the truck is fitted with a derrick which is capable of erecting the pole on completion of the excavation. The author witnessed the erection of 45-foot poles in a back alley in Detroit by means of this equipment. The subsoil was a hard clay, and it took the machine 4½ minutes to bore a 6-foot hole, and a total of 6½ minutes to place the pole in position ready for tamping. One foreman and two skilled men represented the whole gang. All the telephone companies also have a number of three-ton trucks fitted with derricks for pole erection. On country roads, where the poles are laid out along the road in advance and the holes have been excavated, it is possible to erect 25-foot poles at the rate of about 40 an hour under favorable conditions. The maximum number erected in an eight-hour day by one foreman and eight men using one three-ton truck is 300.

In conclusion the author remarked that when the speed with which telephone construction is carried out was first realized it was imagined that the quality of the work must necessarily suffer. Investigation, however, showed that this was not the case. There are several reasons for this unexpected combination of high quality and rapid output. The ready acceptance of machinery and labor-saving devices by the working man and the fact that they have been used to their full capacity have been conducive to high efficiency. Trade unionism exists to some extent, but there is no desire to hamper output. The men readily accept any suggestions for speeding up the work, as they believe it will be to their advantage to reduce costs; in consequence it has been possible to place the majority of telephone workmen on the staffs of the various companies rather than on an hourly basis. They receive a good weekly wage, and enjoy privileges in regard to holidays, sickness, pensions, etc., which attract a good class of men. Another important point is the prospect of promotion to the higher grades for all ranks. It is a fact that any position in the Bell System is open to anyone who becomes qualified for it. Among the jointers are men who have graduated in a university; they have started at the bottom, but they do not stay there long. The actual hours worked are not long, but while the men are on duty they work hard and well.

Making Petroleum from Colza Oil

A FRENCH scientist, M. Alphonse Mailhe, has been making some interesting experiments with regard to the effect of catalysers upon vegetable oils. He first observed that the decomposition of linseed oil upon a mixed catalyser, copper magnesia, led to the formation of a gas having a high degree of calorific power and a liquid which, after having been hydrogenated upon nickel at 180 degrees, was found to consist of a mixed petroleum made up of formenic and cyclic hydro-carbons with the latter predominating. At a session of the French Academy, held October 17, 1921, he made a report stating that most vegetable oils behave in the same manner. He mentioned in particular the treating of colza oil over a copper alumina catalyser in a copper tube at a temperature of 550 to 650 degrees Centigrade. This treatment resulted in the formation of non-condensable gases and a liquid. The gas, which has a high illuminating power, consists of ethylenic and formenic carbides and of hydrogen accompanied by carbon monoxide and carbon anhydride.

The liquid formed, which was chestnut brown in color, readily yielded two fractions, one boiling at 150 degrees Centigrade and the other at 250 degrees. When the residue was passed over the catalyser the second time fresh quantities of these products were formed. After being treated with dilute soda and water each of these liquids was hydrogenated over nickel at 180 degrees. These results show that the decomposition of colza oil under the conditions stated results in a mixture of cyclic and formenic hydrocarbons. Thus it appears that it may be possible to produce at will any given petroleum containing chiefly cyclic carbides which are either simply cycloformenic or else both aromatic and cycloformenic. If the range of raw materials can be made sufficiently wide, this process may aspire to a place in the future program comparable with that held by the manufacture of vegetable alcohol fuel.

Overhauling the Human Mechanism

Some of the Extraordinary Things That the Twentieth Century Surgeon Has Learned to Do

By William A. McGarry

THE possibilities conjured up in the most prosaic imagination by even a casual summary of happenings at the Eleventh Annual Congress of the American College of Surgeons, held in Philadelphia recently, make an appeal of outstanding general interest. Perhaps the most amazing single item was the war-born work in facial reconstruction. But at first glance the rebuilding of a human face seems a phenomenal achievement, its importance to the whole public dwindles perceptibly in comparison to some other trails that daring surgeons are blazing with encouraging success in sections of the human body almost uncharted, so far as the knife of the operator is concerned.

The brain, for instance, has been approached by the most skilful surgeons, even in recent years, with hesitancy. Intra-cranial operations have been a last resort. By actual operations at the recent Congress it was demonstrated not only that this condition no longer exists, but that the specialist in brain surgery is now as sure of his ground as the bone-setter. In the presence of famous surgeons from many countries of Europe and South America one surgeon, working by the light of a tiny electric bulb inserted into the hole which he had cut in the patient's skull, performed an operation consuming more than two hours.

This use of electricity is a natural development of steps taken by surgeons in earlier years. Six years ago at a Congress of the College a daring surgeon operated on a boy who was subject to fits. The ordinary diagnoses had failed to disclose any sign of a blood clot. Knowing the exact spot on the face of the child at which the contractions started, the surgeon made a small opening in the skull and with an electric needle gently touched the surface of the brain over a widening area. When the muscular contractions resulting occurred at the point where the fits always had their start, the surgeon examined the interior of the skull and found a small piece of scar tissue. This was removed, and the boy recovered.

Since then a famous Baltimore surgeon has made possible the definite location of brain tumors and other obstructions by X-ray. Until a few years ago X-ray pictures of the brain were of little value, because the fluid produced in the spine and which passes up over the brain surface and through the ventricles is of the same consistency photographically as the actual brain cells. The Baltimore surgeon discovered that the fluid could be withdrawn through a small hole bored in the back of the skull, thus letting in the air, with no ill effects to the patient. An X-ray plate then gave a clear impression of the brain and of a tumor or other malignant growth.

The use of an electric bulb within the skull robs cerebral surgery of one of its greatest difficulties. This was demonstrated at the Congress by Dr. Charles Frazier, a specialist in this field of the profession. The patient was a middle-aged woman. She was wheeled into the clinical amphitheater of the University Hospital, strapped upright in a chair, a position which surgeons now recognize as superior for intra-cranial operations. A steel brace held the head rigid and in position. Bandages covered all but the small area over the left temple where the operation was to be. During the early stages of the operation, while the skin flap was being laid back and the surgeon was cutting through tissues to the bone without disturbing essential nerves and muscles, the amphitheater was illuminated by the usual high-power, overhead electric lights.

The beginning of the cut through the bone of the skull was made with a small hammer and chisel. Then a drill was used. When this had penetrated the section, about an inch and a half in diameter, was cut around with an instrument similar to a pair of cutting pliers. With the orifice completed, Dr. Frazier picked up a metal band like the handle of a spoon, to the end of which was the small electric light bulb. This was inserted in the hole, the handle resting on the head and holding the bulb rigid. Then all the overhead lights were extinguished and the surgeons filling the rising tiers of seats could see only a dull red glow in the opening of the patient's skull.

After what seemed an age, during which the fingers of the surgeon's right hand were busy within the skull as he explained to the visiting specialists each step in the operation, he moved back to permit the others to look within. He lifted on the point of an instrument the ganglia which he had been seeking. Then, when the operation was completed, an electrode was introduced into the opening until the point of it touched the motor nerve center. The patient's jaws snapped shut with a click, proving that the motor and not the sensory nerve center had been isolated.

In a general way it might be said that the three years which have elapsed since the armistice have served to crystallize the information that medical science gained in the world war, so that many of the things done under the desperate stress of war are just now coming into general use. Facial reconstruction is in this class. The members of the Congress were particularly interested in the work of Dr. Vilray P. Blair, of St. Louis, who was consulting surgeon to the American Expeditionary Forces in France in charge of reconstruction surgery. He was able to present final statistics, showing that 2600 American soldiers needed the services of this division. Of this number about 2000 were treated abroad and 600 sent home for treatment.

At the outset of his discussion, Dr. Blair emphasized the importance of the work to civilian life by pointing out that larger facial defects are created by cancer operations than by battle casualties, on the average. He predicted that the results achieved in this line are opening up a new field of surgery.

"The most important part of any surgical procedure is a plan," said Dr. Blair, "and the more closely and intimately this plan fits the needs of the case, the better will be the results. In reconstruction of the face, the plan should be as accurate and comprehensive as those used by the oculist, the dentist or the journeyman tailor. In the creation of the plan, we should mimic the methods of the sculptor and tailor who materialize their conceptions in clay or chalk before attacking the marble or cloth.

"If reconstruction surgery of the face should continue to develop along the lines upon which it is well started, I can see no reason why in the majority of cases a really good surgeon, given a healthy patient, the feeling of an artist, the skill of an ordinary tailor and the tenacity of a rat terrier, could not produce in flesh and bone features that compare favorably with those created by the accepted sculptor or painter. But it will require special skill and training and no end of hard work.

"Until such men are trained to work in this line the results must continue to be archaic and not incomparable to the results that would follow if each man were forced to make his own clothes. Satisfaction at one's appearance has a tremendous bearing on poise and self-confidence and, disregarding battle casualties, skill in the correction of facial defects will open up a very substantial field of legislation and much-needed surgery.

"If a man, through being wounded or an accident, has lost his nose, we first make a clay cast of the face without the missing feature. This negative is then filled with plaster and a positive cast made. On this the artist works, developing the missing feature according to the best æsthetic rules. When this is completed, we have the patient's face with the built up new feature in plaster. The added feature is then covered with tin foil and a pattern is made, when the foil is flattened out. From this pattern we cut the cartilage with which we build up the new feature from the patient's body, cut it into shape and apply it to the old wound. Then a piece of adjacent skin is cut to the size covering the newly built feature, and is left joined like a flap in its old position until it begins to graft on the new structure, after which it is cut away."

Perhaps the greatest single constructive action of the Congress was the appointment of a committee that will make a complete survey of the results attained by the use of radium in the treatment of cancer and other malignant growths. This action was the outcome of an unexpected criticism from Dr. John B. Deaver, of Philadelphia. Just after being installed as the new president of the academy, Dr. Deaver said that while he hesitated to express a fear that radium will go the way of other new methods which could not stand the test of practice, the fact is that radium has failed in many cases where it was depended on. He pointed out that it is not by any means a cure-all for cancer and warned the members of the college from placing too much reliance on its value.

Heretofore the results from radium have been made known to the profession as a whole only through the energy of the individual user, or the institution in which he works. The college has created the machinery that will in effect chart the activity of every milligram of radium for every moment of its use, making annual reports. This action was particularly timely in view of the fact that great progress was made at the Congress toward the completion of the fund for the Dr. John B. Murphy Memorial which is to be built in Chicago. Citizens of that city have pledged $300,000 to be paid over when the college raises $200,000.

In this memorial the College of Surgeons will have its own laboratory and research center in which the problems that have baffled the greatest of individual surgeons may be placed before the composite minds of all. It is expected that the fund will be completed and work started within another year, and in that event the radium investigation doubtless will be one of the first launched. Another problem, referred to at the sessions, concerns the expected isolation of the organism in the blood which is now held to be responsible for certain forms of internal hemorrhages that have heretofore been a mystery to science and death to the victim. It was announced that experiments have been made demonstrating that this condition is caused by a germ. The blood of infants stricken with the disease, injected in small quantities into the blood of adults, has caused hemorrhages. Blood transfusion from a healthy volunteer was held out as the best known treatment. Indeed, it was stated that the profession is just beginning to realize the wide range of value of blood transfusion.

AMONG the scientific developments of the present generation none are more marvelous than those of surgery—most practical of all applied science. We recall, some fifteen years ago, when surgery inside the chest was just beginning to be practiced, that a very competent physician and surgeon patiently explained to us six separate and distinct reasons why it could never be done, and why the reports that it had been done were newspaper fabrications. What the same gentleman would say to the prospect of working for two hours within a patient's skull by the light of a tiny lamp introduced therein we can hardly imagine. Such achievements as this make it plain that the surgeon of today takes his patient apart, repairs him, and puts him together again, with somewhat the same freedom displayed by a mechanic in overhauling the internals of an automobile. This story, as revealed by the Eleventh Annual Congress of the American College of Surgeons, Mr. McGarry tells us here.—THE EDITOR.

Specifications for Varnish

THE present high price of varnish for all purposes, and the great variety of uses to which it is applied, both in the home and commercial work, make proper specifications for the purchase of this material a matter of great importance. The government itself is a large user of varnish for both indoor and outdoor use, and samples of all this material submitted to the various departments are tested by the Bureau of Standards.

Two publications, Circulars Nos. 103 and 117 of the Bureau of Standards, have just been issued and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy. They deal with specifications for water-resisting spar varnish and interior varnish, respectively. The specifications are unique in that they state the requirements which a satisfactory varnish must meet, but leave to the manufacturer a very wide latitude in the preparation of the material. This is believed to be a step in the right direction as it allows each manufacturer to follow his own ideas in the composition of the material, the only stipulation being that it shall be satisfactory under the most severe conditions.

A Ten-Year Naval Holiday

Friendly Cooperation Substituted for the Present Naval Competition

SELDOM has the world witnessed an act of more courageous statesmanship than that of Secretary Hughes in his proposal that the leading naval powers should immediately destroy 68 capital ships, totalling over one and a half million tons displacement, and that no more such ships should be built for the next ten years. That this drastic proposal was an exhibition of practical statesmanship for which the whole world was waiting was proved by the acclamation with which it was everywhere received. Our Secretary realized that. The disease of naval rivalry was so deep-seated as to call for a major operation.

Charity begins at home; and nowhere did the American knife cut so deeply as into our own fleet of capital ships. This fact has been everywhere recognized. Self-surgery, such as this, prevented any suspicion arising as to the purity of our motives; and there is no doubt that it contributed greatly to the success of the Conference. Immediately upon the conclusion of Mr. Hughes' address the proposal was heartily accepted in principle by the British and Japanese representatives. The subsequent deliberations have been in the direction of adjustment of details.

In working out its proposals for a limitation of naval armaments the United States was guided by four general principles: first, the practical elimination of all capital shipbuilding programs either actual or projected; second, further reduction through the scrapping of certain of the older ships; third, that regard should be had to the existing naval strength of the conferring powers; fourth, that the tonnage in capital ships should be the measurement of naval strength, with a proportionate allowance of auxiliary fighting craft prescribed.

Displacement, 32,600 tons. *Speed*, 22 knots. *Armament*: Eight 16", fourteen 5" guns. *Armor*: belt, 18"; gun positions, 12" to 18"; torpedo tubes, two 21"

"Maryland," first U. S. battleship to mount the 16-inch gun. We retain three of this class

The United States

The United States undertakes to destroy all but two of its new capital ships which are now under construction and progressing to completion. This includes the six battle cruisers and seven battleships which are now under construction, but it excludes the "Washington" and "Colorado," sisters to the "Maryland," which have been launched and are from 60 to 80 per cent completed. The total tonnage of these 13 ships on completion would have been 552,800.

The United States also undertakes to destroy all battleships up to and including the "Delaware" and the "North Dakota." There are fifteen pre-dreadnought ships in our Navy, and their tonnage amounts to 227,740. Adding this to the total given above for the battleships and battle cruisers, we arrive at a grand total of capital ships to be destroyed of 30 vessels, aggregating 820,540 tons.

Great Britain

Great Britain undertakes to cease construction of two new battleships of the "Hood" class, which on November the 11th, 1921, had not yet been laid down, but upon which money had been expended. These two ships represent a total tonnage of 86,000.

In addition to the two ships of the "Hood" class, Great Britain undertakes to destroy eight dreadnoughts which are at present in her first line. These are the "Orion," "Thunderer," "Monarch" and "Conqueror," vessels of 24,500 tons, armed with ten 13.5-inch guns; the "Erin" of 23,425 tons and ten 13.5-inch guns; and the "King George," "Centurion," and "Ajax" of 24,100 tons, armed with ten 13.5-inch guns.

In addition to these she undertakes to scrap fifteen dreadnoughts and battle cruisers, making in addition to the "Hoods," as mentioned above, a total reduction in tonnage of 507,100 tons. The grand total of capital ship tonnage to be destroyed totals 593,100 tons.

Great Britain is not called upon to destroy any pre-dreadnoughts, having already scrapped them all to the extent of about 270,000 tons.

Japan

Japan undertakes to abandon her program for the building of ships which are not laid down, namely, the "Kii," "Owari," No. 7 and No. 8 battleships, and Nos. 5, 6, 7 and 8 battle cruisers. It should be noted that this does not involve the stopping of construction upon any ship upon which construction has already begun.

Japan is also called upon to scrap two battleships: the "Tosa" and "Kaga," which are under construction; four battleships, the "Amagi" and "Akagi," which are building, and the "Atago" and "Takao," which are not yet laid down, but for which certain material has been assembled.

The above involves a reduction of six new capital ships which are under construction, whose total tonnage is 254,100 tons.

Japan undertakes also to scrap all pre-dreadnoughts and capital ships of the second line, which will involve the destroying of all ships up to and including the "Settsu." This involves the destruction of 11 of the older ships, with a total tonnage of 181,228. The grand total of reduction is 435,328 tons.

France and Italy

Regarding France and Italy, the American proposals as first set forth by Secretary Hughes had to say: "In view of certain extraordinary conditions due to the World War affecting the existing strength of the navies of France and Italy, the United States does not consider necessary the discussion at this stage of the proceedings of the tonnage allowance of these nations, but proposes it be reserved for the later consideration of the Conference."

The final ratio adopted for the five powers concerned was 5–5–3–1.7–1.7.

Replacement After Ten Years

It is agreed that no new capital ships shall be constructed during the next ten years, except such replacement tonnage as is provided by the agreement.

The tonnage basis for capital ship replacement is as follows: the United States, 525,000 tons; Great Britain, 525,000 tons, and Japan, 315,000 tons. Under this agreement capital ships are reckoned to be obsolete 20 years from the date of completion. This, it will be noted, is five years longer than has been accepted of late years as the limit of usefulness for a capital ship. Capital ships 20 years from the date of completion may be replaced by new capital ship construction, the keels of such new construction to be laid when the ship is 17 years old; but the first replacement tonnage must not be laid down until 10 years from the date of the signing of the agreement. The scrapping of capital ships replaced by such new construction shall be undertaken not later than the date of completion of the new construction.

No Capital Ship Above 35,000 Tons

A most important reservation is that regarding the size of capital ships, which, it is agreed, shall not exceed 35,000 tons. The rapidly-growing size of capital ships has been one of the most alarming facts of the naval problem. Under the spur of competition each navy naturally aimed to outbuild existing ships in speed, gun-power, protection, et cetera, with the result that we have moved up in the last 10 or 12 years from the 20,000-ton "North Dakota" to the 28,610-ton "Queen Elizabeth," the 32,600-ton "Maryland" and the 43,000-ton "Hood." Preponderance of power gained through big displacement of the individual ship will no longer figure in future navies.

Auxiliary Fighting Craft

In the agreement, auxiliary fighting craft have been divided into the three heads of auxiliary surface craft, submarines, and aircraft carriers and aircraft. Under surface fighting craft are included cruisers (exclusive of battle cruisers), destroyer flotilla leaders, destroyers

SUMMARY, SHOWING COMPARATIVE STRENGTH

	No. of Ships	Heavy Guns	Energy, Foot-Tons	Displacement in Tons	Displacement in Tons, Modified by Age
United States	18	192	13,385,176	525,850	416,259
Great Britain	20	164	12,773,360	582,725	447,837
Japan	10	96	6,755,680	313,300	247,430

and all other surface types except existing monitors and unarmed surface craft under 3000 tons, fuel ships, supply ships, tenders, repair ships, mine sweepers and vessels readily convertible from merchant vessels. No new auxiliary fighting craft may be built exempt from the agreement that exceed 3000 tons displacement and 15 knots speed and that carry more than four 5-inch guns.

The total tonnage of cruisers, flotilla leaders and destroyers allowed each power is: for the United States, 450,000 tons; for Great Britain, 450,000 tons, and for Japan, 270,000 tons. If the total tonnage in auxiliary surface fighting craft of any power exceeds today the prescribed tonnage as given above, such excess need not be scrapped until replacements begin, when the total tonnage for each nation must be reduced to the prescribed allowance. All auxiliary surface fighting craft whose keels had been laid by November 11th, 1921, may be completed; but no new construction except replacement tonnage must be laid down during the period of the agreement.

Allowance of Submarines

Each power is allowed a specified total tonnage of submarines which is as follows: the United States, 90,000 tons; Great Britain, 90,000 tons, and Japan, 54,000 tons.

It is possible that there will be some modification of this arrangement. Both Great Britain and the United States will have to increase rather than reduce their submarine fleets, and it has been urged that such addition is inconsistent with the purpose of the Conference, which aims at all-round reductions. The agitation in favor of the total abolition of the submarine, which prevailed at the Versailles Conference, showed some signs of revival at the present Conference. The argument against the submarine was based chiefly upon the possibility of some power resorting to the atrocious misuse of it, which was one of the most damning indictments against Germany in the recent war. If the submarines were to be prohibited altogether, it was urged, no such abomination would become possible. On the other hand, it was argued that the submarine is essentially the weapon of the weaker power.

Aircraft Carriers and Aircraft

The agreement assigns a specified tonnage of aircraft carriers to each navy, the United States being allotted 80,000 tons, Great Britain, 80,000 tons, and Japan, 48,000 tons. If any power possesses today a tonnage in excess of this amount, it is not under obligation to scrap such excess until replacements begin, at which time the total tonnage shall be reduced to the prescribed allowance. Airplane carriers whose keels have been laid down may be completed. No new airplane carrier tonnage except for replacement shall be laid down during the period of the agreement.

Replacement of Auxiliary Fighting Craft

Cruisers that are 17 years old may be replaced by new construction; but the keels for such new construction shall not be laid until the tonnage it is intended to replace is 15 years of age from the date of completion.

Destroyers and flotilla leaders may be replaced when they are 12 years old; and the same age applies to replacement of submarines. Airplane carriers may be replaced after they are 20 years of age; but the keels of such new construction must not be laid until the tonnage which it replaces is 17 years of age from the date of completion.

Because of the fact that naval aircraft may be readily adapted from special types of commercial aircraft, the Conference did not consider that it was practicable to prescribe any limit for such.

A final and very important clause of the agreement binds the parties to it not to dispose of any war vessels in any class in such a manner that they may later become combatant war vessels in another navy. Further, they bind themselves not to acquire war vessels from any foreign source. Another clause looking in the same direction is that which binds the signatories not to construct any capital ship tonnage or auxiliary fighting craft tonnage for foreign account.

The last clause of the agreement refers to the merchant marine and states that as the importance of the merchant marine is in inverse ratio to the size of naval armaments, regulations must be provided to govern its conversion for war purposes.

Such is an outline of this momentous agreement. It bears evidence of a painstaking inquiry into the strength of the navies concerned and the responsibilities which they severally bear. The agreement has been accepted by the United States, Great Britain and Japan, and the exceptions which were taken to it were not found to present any insurmountable difficulties. By acceptance, the powers concerned have relieved the future of a fearful menace. That is the negative gain. Greater than this, however, is the positive gain of the development of a spirit of confidence and cooperation among the three leading naval powers of the world.

CAPITAL SHIP STRENGTH AS DETERMINED BY THE ARMAMENTS CONFERENCE

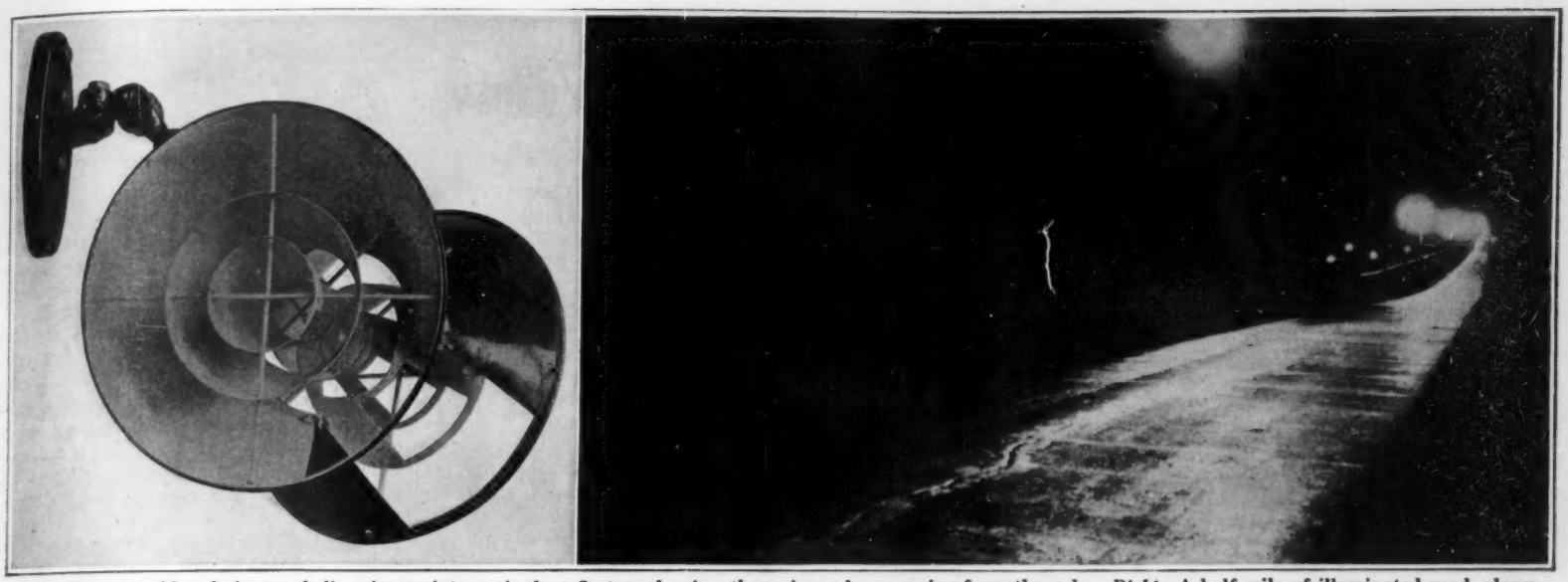
Displacement–Efficiency in Last Column Estimated on 20-Year Life Assigned by Conference

Capital Ships	Heavy Guns	Broadside Energy Foot-Tons	Date Completed	Displacement in Tons	Years Old, Nov. 11, 1921	Fraction of 20-Year Life Remaining	Displacement-Efficiency as Reduced by Age
United States							
Maryland	Eight 16″	792,000	1921	32,600	0	20/20	32,600
Colorado	Eight 16″	792,000	1921	32,600	0	20/20	32,600
Washington	Eight 16″	792,000	1921	32,600	0	20/20	32,600
California	Twelve 14″	914,160	1921	32,300	0	20/20	32,300
Tennessee	Twelve 14″	914,160	1920	32,300	1	19/20	30,685
Idaho	Twelve 14″	914,160	1919	32,000	2	9/10	28,800
Mississippi	Twelve 14″	914,160	1917	32,000	4	4/5	25,600
New Mexico	Twelve 14″	914,160	1918	32,000	3	17/20	27,200
Arizona	Twelve 14″	787,272	1916	31,400	5	3/4	23,550
Pennsylvania	Twelve 14″	787,272	1916	31,400	5	3/4	23,550
Oklahoma	Ten 14″	656,060	1916	27,500	5	3/4	20,625
Nevada	Ten 14″	656,060	1916	27,500	5	3/4	20,625
Texas	Ten 14″	656,060	1914	27,000	7	13/20	17,550
New York	Ten 14″	656,060	1914	27,000	7	13/20	17,550
Arkansas	Twelve 12″	629,746	1912	26,000	9	11/20	14,300
Wyoming	Twelve 12″	629,746	1912	26,000	9	11/20	14,300
Utah	Ten 12″	490,000	1911	21,825	10	1/2	10,912
Florida	Ten 12″	490,000	1911	21,825	10	1/2	10,912
Totals	192	13,385,176		525,850			416,259
Great Britain							
Hood (modified)	Eight 16″	817,280	....	37,000	0	20/20	37,000
Hood (modified)	Eight 16″	817,280	....	37,000	0	20/20	37,000
Royal Sovereign	Eight 15″	658,400	1916	26,600	5	3/4	19,950
Royal Oak	Eight 15″	658,400	1916	26,600	5	3/4	19,950
Resolution	Eight 15″	658,400	1916	26,600	5	3/4	19,950
Revenge	Eight 15″	658,400	1916	26,600	5	3/4	19,950
Ramilies	Eight 15″	658,400	1917	26,600	4	4/5	21,280
Queen Elizabeth	Eight 15″	658,400	1915	28,925	6	7/10	20,247
Warspite	Eight 15″	658,400	1915	28,925	6	7/10	20,247
Barham	Eight 15″	658,400	1915	28,925	6	7/10	20,247
Valiant	Eight 15″	658,400	1916	28,925	5	3/4	21,694
Malaya	Eight 15″	658,400	1916	28,925	5	3/4	21,694
Benbow	Ten 13.5″	606,000	1914	25,850	7	13/20	16,803
Empress of India	Ten 13.5″	606,000	1914	25,850	7	13/20	16,803
Iron Duke	Ten 13.5″	606,000	1914	25,850	7	13/20	16,803
Marlborough	Ten 13.5″	606,000	1914	25,850	7	13/20	16,803
Hood	Eight 15″	658,400	1920	43,000	1	19/20	40,850
Renown	Six 15″	493,800	1916	27,550	5	3/4	20,663
Repulse	Six 15″	493,800	1916	27,550	5	3/4	20,663
Tiger	Eight 13.5″	484,800	1914	29,600	7	13/20	19,240
Totals	164	12,773,360		582,725			447,837
Japan							
Nagato	Eight 16″	745,840	1921	35,000	0	20/20	35,000
Mutsu	Eight 16″	745,840	1921	35,000	0	20/20	35,000
Hiuga	Twelve 14″	789,600	1918	32,750	3	17/20	27,837
Ise	Twelve 14″	789,600	1917	32,750	4	4/5	26,200
Yamashiro	Twelve 14″	789,600	1917	32,000	4	4/5	25,600
Fuso	Twelve 14″	789,600	1915	32,000	6	7/10	22,400
Kirishima	Eight 14″	526,400	1915	28,450	6	7/10	19,915
Haruna	Eight 14″	526,400	1915	28,450	6	7/10	19,915
Hi-Yei	Eight 14″	526,400	1914	28,450	7	13/20	18,493
Kongo	Eight 14″	526,400	1913	28,450	8	3/5	17,070
Totals	96	6,755,680		313,300			247,430

Atmosphere a Giant Engine

IN the annual Reds lecture delivered at Cambridge, Sir Napier Shaw, Professor of Meteorology at the Imperial College of Science and Technology, said he wished to generalize the atmospheric processes in such a way as to make them amenable to established physical laws. He would regard the atmosphere as a giant steam engine. A steam engine had a boiler, a condenser and a flywheel. The boiler of the atmosphere was the warm surface of earth and sea, the condenser some cold surfaces in the Polar regions and the great mountains, but principally the cold regions of the upper air.

The flywheel was made up partly of the normal winds and partly of the semi-permanent winds of cyclonic depressions. The normal winds grouped themselves into two great circulations — on one hand a great circumpolar circulation in the upper air in which air traveled from west to east, and, on the other hand, a comparatively narrow equatorial belt of air continually passing westward. Between the two, over the great oceans, were permanent anticyclonic circulations, huge traveling bands of air, a couple of thousand miles long (west to east) and a thousand miles wide (north to south). They reminded one of the driving belts of the war tanks in their movements. As they moved round like a driving belt they carried forward the westward moving air of the equatorial circulation on the south side and eastward moving the air of the polar circulation on the north side. They were thus the gear that kept the main flywheels in working order. He attributed much importance to this aspect of the flywheel. It was what long-distance air travelers will have to take chiefly into consideration in the future. By taking advantage of the equatorial portion in the fifteenth century Columbus reached America, and similarly, in the twentieth century, by taking advantage of the circumpolar section, Alcock crossed the Atlantic in an airplane in 16 hours, thus achieving the first nonstop transatlantic airplane flight.



Left: **The assembly of six parabolic mirrors into a single reflector, showing the universal suspension from the pole.** ***Right:*** **A half-mile of illuminated road, along which objects stand out in a silhouetted outline sharper than that displayed in ordinary daylight**

The Last Word in Illuminated Highways

An Invention That Calls for the Reversal of a Recently Expressed Editorial Opinion

By J. Malcolm Bird

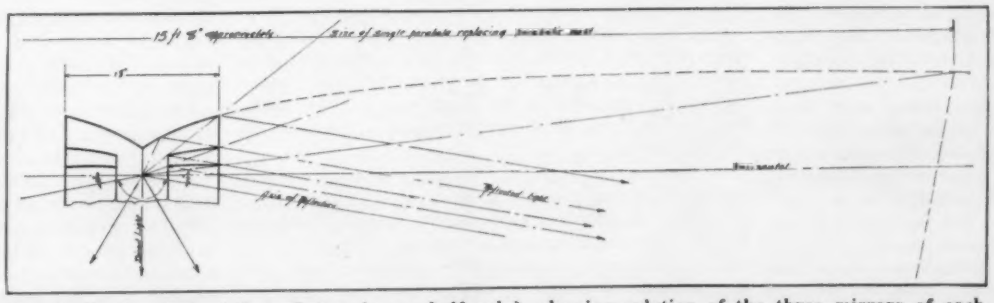
MOST automobilists will agree that on the basis of past experience the opinion which I set forth editorially in our issue of Oct. 1st, 1921, is correct. I pointed out that so far as successful illumination of the road is concerned one's headlight is superior to pole lights at the side of the way. Everyone who drives at night must have had experiences, startling if not actually leading to accident, which illustrate this. One drives through alternate zones of illumination near the poles and semi-darkness between them until one's power of eye-accommodation is paralyzed, and the alternation of dazzle and darkness becomes a menace to safety. And one's headlights, which are uniform and agreeable in the illumination they afford, are useless; the pole lights interfere with their action and leave the road substantially unilluminated. The morning papers of the very day on which I write tell of a driver in whose behalf the strongest presumption of competence and careful driving exists, who was killed on a lighted thoroughfare by running into a truck standing without tail-lights. I have had the narrowest escape from a similar accident, being saved only when the headlight of an approaching car—fortunately a grossly illegal one—threw the obstruction up in silhouette. On an illuminated highway of the familiar type I think there is no argument against the proposition that visibility is dangerously low. So in view of the effective work that has been done to meet the problem of glaring headlights, I expressed the definite preference for a road wholly unlighted save for such specific indication of acute danger spots as might seem desirable.

It is easy enough to locate the reason for the unsatisfactory character of road lighting as practiced. Most illuminated roads are lighted because they are really streets. Either they run out into the country as a continuation of some important city street, like the Albany Post Road out of New York, or else they form a common main street for a series of towns and cities like those that line the Central Railroad of New Jersey from Elizabeth to Somerville, or the New York-Boston route practically all the way into Bridgeport. In either event the lighting of the country stretches has grown up as an offshoot of the lighting of the built-up sections; the same principles have been applied, where in reality they do not at all apply.

In the first place, city streets develop crossings every 200 feet or so, where at the very worst we have lights shining through from both streets and affording double illumination, and where often we have extra lamps, traffic markers, spotlights, illuminated buildings, etc. In the second place, along city streets the line of houses is more or less continuous; and while the reflection factor is far from 100 per cent, it is by no means zero. In the third place, the curb marks a definite, tangible and unmistakable limit of navigability on the one side, while the center of the street is often marked by car tracks or other means; and there is always light enough to see these marks. Finally, the effective width of the city street is usually far more than that of the road—even of the road that is considered worth lighting.

As we go out into the open country all these factors disappear; yet the character of the lighting is modified in no wise save that the lights are probably farther apart. In the bargain, the way is in general less straight and less level; in addition to its general decreased width it has bridges, culverts, cuts and fills where the necessity for not encroaching on the sidelines is imperative; and moving shadows are far more prevalent. Is it any wonder that the lighting scheme that works so well in the city is a disastrous failure in the country?

Suppose we plant a pole beside the road, and at its top place an electric lamp of any candlepower you please. Throwing its light uniformly in all directions, a small part indeed of its capacity is put to work upon the road. It is absurdly evident that we can not light all outdoors; yet the effort to do so is absurdly prevalent.



Longitudinal section of the reflector (upper half only), showing relation of the three mirrors of each half, zones of reflected and direct light, and utilization by each mirror of the light that is not used by the one outside it

Suppose, now, we attempt to meet this dispersion by the use of reflectors. Suppose we put a reflector above the lamp to divert downward the 50 per cent of the light that would ordinarily go up; and one behind it to cut off and utilize that half of the remaining 50 per cent that would ordinarily be directed away from the road. Our field of attempted illumination is now reduced to a mere quarter of all outdoors; but we shall have as little success as we had before. We must concentrate our light upon the road, and on the road alone.

In a given direction from the lamp the road begins at a definite distance from the pole and ends after another definite distance. As we sweep around the semicircle from parallelism with the road in one direction, through actual perpendicularity and back to parallelism, these distances decrease to a minimum and then increase again. If the pole is set five feet back from a 30-foot road, the ray that drops straight across the way must start work five feet from the pole and finish 35 feet from it; it should be focused in a way that confines it entirely to this interval. The ray that strikes the road at a 30-degree angle, on the other hand, must be effective over a distance of 60 feet, but this does not begin until we get 10 feet from the pole. No mere reflector will do all this; we must have active focusing as well. We must have a variable focusing that meets the variation we have exemplified, and at the same time we must have such distribution that there are no dark intervals. Incidentally, it must be true distribution, and nothing approaching a searchlight beam, with its glare.

And there we are: it sounds like a pretty problem, and indeed it is just that. The layman might be forgiven for doubting that it would have any solution, and even the technologist might well harbor an uneasy feeling on the subject. But the illuminating engineers of the Schenectady laboratory were not willing to give it up; they stayed with it until they found a solution. The form in which they found it bears out all we have said about the presumptive difficulty of the problem; for in order to achieve the desired results they have had to use no less than six distinct mirrors, of definite size, shape and arrangement. We need describe only three of these, for the assembled reflector is symmetric, with the lamp in the middle.

The individual mirrors are paraboloids, like the one behind the ordinary headlight; but they are somewhat longer extended than these. The three of them are nested around a common axis and common focus; and the closed ends have been cut off—truncated, as the geometer would put it. The mirrors are thus shaped like long narrow cups without any bottoms. The necessity of this is apparent, in order that all three of them may function on a single lamp without getting in each

(*Continued on page 152*)

Our Point of View

A Reminiscence of Marconi

THE editor of this journal recently had the unique experience of addressing an audience estimated roughly at 50,000, through the radio broadcasting service which a noted electrical company has established at Newark, New Jersey. The magic of the thing lay in the very quiet and ease of it all. Just an armchair, an ordinary commercial telephone outfit, and quiet speech such as one would have across the table with a friend over coffee and cigars. It was natural—inevitable, in fact—that into our subconscious mind, while we were engaged in that little talk, there should come the image of Marconi as we saw him and talked with him twenty-two years ago in the pilot house of "La Grande Duchesse," an ocean steamer that had been requisitioned for the first display of "Marconi wireless" in the United States.

Marconi's apparatus consisted of a receiving and transmitting set, and a wire which led out through the roof of the pilot house to the masthead, and provided a single vertical antenna 120 feet in height. The receiving apparatus included a small glass tube (the coherer) which contained two silver pole pieces with their ends about one-fiftieth of an inch apart. Between the ends was a mixture of nickel and silver filings with a trace of mercury. Normally, because of their resistance, the filings prevented the flow of current. When the radio waves were received, the resistance broke down and the local current passed through. Marconi had arranged a small hammer, which rapped continuously upon the coherer by means of a local circuit which was closed when the radio waves passed through the metal filings. When the waves ceased, the hammer gave its last rap and the tube was left in a de-cohered condition ready for the next transmission. Messages were relayed from this station to the Bennett-Mackay cable steamer anchored near Sandy Hook lightship, and to a station at the Navesink Highlands. Both of these stations had cable connections with New York. No great range was called for, since the yachts on no part of the course were more than fifteen miles from the starting point at the lightship; and the system worked satisfactorily.

On the last leg of the course, when "Columbia" was leading Sir Thomas Lipton's "Shamrock I" by a margin which spelled certain victory, and there was a breathing spell for the wireless operator, who was of course the inventor himself, the writer asked Marconi whether he expected ever to send wireless messages across the Atlantic. He smiled, lifted his hand deprecatingly and said: "I have covered 170 miles in England; I am now aiming at 500; then I shall try for a thousand. Across the Atlantic? Perhaps. We shall see." If we had predicted to Marconi that, twenty-two years from that day, the speaker would be sitting in an armchair and talking to an audience of some 50,000 people, many of them over a thousand miles distant and most of them seated in the quiet of their own homes; or if we had told him that the next day the SCIENTIFIC AMERICAN would be sending a Christmas message to that intrepid explorer, Sir Ernest Shackleton, when two months out on his trip to the Antarctic—we wonder what Marconi would have said.

The First Fruits of the War

WE have gathered in the first fruits of the war.

When the Conference on the Limitation of Armaments assembled in Washington on November 11, 1921, the world was facing the two alternatives of friendly cooperation or war. There can be no doubt about that. Japan had answered our naval activity with her eight-eight program; Great Britain had laid down four great ships of the "Hood" class; the war scaremongers were busy fanning the sparks of resentment and suspicion and—well, it was the old, old story, and it could have had but one sad ending.

As our readers are well aware, the SCIENTIFIC AMERICAN has always protested against the completion, after the war was won, of our great naval program. We did so because we foresaw that our continued naval activity would reawaken that shipbuilding rivalry which, logically, should have died down when the Armistice was signed. Always we have had a profound admiration for the United States Navy—always we have endeavored to strengthen its hold upon the imagination of the country and win for it the loyal support of the people and its Congress. Following the Armistice, we would have liked to see, we expected to see, the Navy set an example of disarmament, by cancelling, or at least modifying, its great war program.

That was to come three years later, and to the everlasting credit of the Navy let it be said that, when our President and the Secretary of State called upon their naval advisers to formulate a plan of disarmament, our experts made such a sweeping reduction of our capital ship program as to put the purity of our motives in calling this conference beyond all question. With one stroke of the knife they cut out the six magnificent battleships of the "Indiana" class; the six 33-knot battle cruisers of the "Constellation" class; and even proposed to break up three sister ships to the "Maryland" that were within easy reach of completion.

The effect was immediate. No sooner was the proposal read by Secretary Hughes than it was accepted by Great Britain and Japan; and as soon as the full import of the proposal was understood, a sentiment of approval and appreciation swept around the world. "Peace hath her victories no less than War"; and bright as is the roll of successes won by the skill and daring of our Navy in its famous engagements on the high seas, none was greater, none called for such self-denial, none demanded such unquestioned moral courage, and none, surely, in the years to come, will be regarded with more exalted national pride, than this victory of Peace, which was won at the very opening of the recent conference.

How complicated and difficult was the task of adjusting the three navies, and arranging an equitable assignment of ships under the 5-5-3 ratio, only a naval expert can fully appreciate. In spite of some inevitable criticism, the proposal has met with practically universal endorsement. Not even the most carping critic has dared to suggest that we have favored our own at the expense of the other two navies. The possibility of that imputation was shut out by the fact that we suggested scrapping our own fleet of battle cruisers and permitting Great Britain and Japan to keep theirs. Impartiality was shown, also, in allotting to Great Britain a twenty per cent excess of capital ship tonnage over our own, on the ground that her latest battleships were already five years old, and her whole fleet had suffered more age-depreciation than ours or that of Japan.

We have spoken of the credit that is due to the naval experts who prepared the program of limitation. But precedent to that was the masterly work of Senator Borah, who, single-handed, swung the Senate into line with a unanimous vote for the movement, and thus strengthened the hand of the President and Secretary Hughes in inaugurating the great movement which has now so nobly been consummated.

The Crying Need of the Patent Office

IT seems almost incredible that it should be necessary to reiterate the great need of the United States Patent Office to be placed upon a basis commensurate with its needs and the requirements of the country. But the appeals that have been made from time to time through the Commissioners of Patents in regard to the conditions within the Patent Office have been widely known throughout the country, and still Congress has failed to bring about the reforms that have been called for. Whether this is due to carelessness, to the rush of other business or to the fact that no particular patronage is at stake it is not for us to decide at this time. It is sufficient to say that these needs are well known to the people at large, even if they are not heeded by members of Congress, and it is to be hoped that some action will be taken to remedy the difficulties and defects of the present system. It is unthinkable that this great branch of our Government should suffer through inattention and neglect on the part of our legislators.

The plea for economy which is being exercised in so many departments of the Government need not apply to the Patent Office, owing to the fact that it holds at the present moment about $8,000,000 in the Treasury. Every year, but one, since 1862 there has been a surplus turned into the Treasury by the Patent Office. During all this time there has been but one increase in salaries to the Examiners and that of only 10 per cent. During the World War naturally the Patent Office force was greatly depleted; and since then, Congress has declined to increase the salaries sufficiently to attract men of the type that the Patent Office needs.

The difficulty with the whole system lies in the fact that it is nobody's particular business to see that the needs of the Patent Office are complied with and that the machinery of the Patent Office is so well oiled that its creaking will not be heard outside. But the time has been reached when something must be done and that something must be done very soon.

In a report made in July, 1921, by Mr. Robertson, Commissioner of Patents, it was pointed out that from July, 1919, to June 30th, 1921, "the Patent Office suffered a loss of 163 examiners. These men, who were scientifically trained and also members of the bar, have been replaced by inexperienced men, fresh from college, without any knowledge of patent law or any legal training. Moreover, the men who resigned were familiar, through years of experience, with the particular art with which they were engaged, and it takes years to train new men to their places."

During the fiscal year ending June, 1920, the Commissioner of Patents reports, there were received in the Patent Office 62,755 applications for patents, while during the year immediately following there were 84,248 applications, or an increase of 34 per cent. The trade-mark applications jumped from 8561 to 15,884, or an increase of 85½ per cent.

The Committee on Patents of the House of Representatives last June unanimously favored the enactment of H.R. 7077, designed to meet this situation. The Senate Committee on Patents also reported in favor of substantially this bill, stating in their report that "the employees of this office, to a great extent, are technical and scientific men. It has been recognized for many years that the salaries paid in the Patent Office were not sufficient to retain the kind of men that are absolutely necessary if we keep up the efficiency of the office. At the present time, the office is far behind in its work, and with existing salaries it is found to be impossible to keep an organization of trained men."

It is a well-known fact that millions of dollars are invested, directly or indirectly, in the manufacture of patented inventions throughout the United States. The number of people employed in various manufacturing plants throughout the country amounts to many millions, and still the business of the Patent Office is allowed to languish through the inertia of Congressional action. It is the height of inconsistency for the Government to spend money in an endeavor to relieve the unemployment situation when an inventor with a new, meritorious product must wait many months before receiving the initial action of the Patent Office that would justify him or his financial backer in proceeding with manufacture which may employ hundreds of idle men.

It is inconceivable that the bill which is now before Congress should not result in some effective action to relieve conditions in the Patent Office. But the apathy of members of Congress is so great that unless some

Our Point of View

move is made from without it is feared that this important bill will not be acted upon. If you, therefore, have this matter greatly at heart, it is important to write now to your Senators and your Congressman that Bill H.R. 7077 should be passed immediately.

Battle Cruisers as Ocean Liners

IT was inevitable that the proposal of the Conference to scrap our six battle cruisers should suggest the thought that they might profitably be completed as ocean liners. Were that done, their great length of 875 feet and their beam of over 100 feet would put them in the class of the largest ocean liners of the "Leviathan," "Aquitania" and "Olympic" type. Although in displacement they would be from 15,000 to 20,000 tons less than those ships, in speed, if it were so desired, they could be made greatly to surpass them. Candidly, we do not believe that this change will ever be made for the reasons, first, that, at least in the case of the more advanced ships, it would cost as much, if not more, to complete them as passenger ships, as it would to build entirely new vessels of equal tonnage, from the keel up; secondly, because they would be uncomfortable and very wet in a seaway; and thirdly, because they would not be economical in operation.

The best point in favor of such reconstructed vessels would be their safety against loss by collision. The submerged portion of the hull is subdivided into many hundred separate compartments, big and little. It might be said without exaggeration that below water there are from four to six hulls, one within the other, and each separated by a few feet of lateral distance from the one outside of it. Not only so, but this longitudinal subdivision is itself subdivided transversely by a vast number of bulkheads. The underwater projecting ledge of an iceberg that ripped open five forward compartments of the "Titanic" and sent her to the bottom, would scarcely affect the stability of one of these ships; and the amount of flooding that ensued could be quickly controlled by the ship's pumps.

It is this bewildering amount of subdivision that would be one cause of the great cost of reconstructing a battle cruiser for passenger service. To provide the passenger, baggage, mail and other accommodations proportionate to a ship of this size, it would be necessary to remove the greater part of the subdivision above referred to—a slow and costly job. Then, such transverse bulkheads as remained would have to be extended to the ship's outer shell. Indeed, we do not know whom to pity most—the naval architect who would have to design the reconstruction, or the constructing engineer who would have to carry it through.

In addition to clearing out the ship below water level, at least two, and probably three decks for passenger accommodation would have to be added. Furthermore, to make the vessel a good sea boat, it would be necessary to raise the freeboard from stem to stern. The "Mauretania" has 45 feet of freeboard forward, the "Leviathan," probably 52 or 53 feet; but the battle cruisers have only from 30 to 35 feet of freeboard. The addition of this bulk and top weight would have no ill effect upon the stability, for the reason that the heavy weights of side armor, barbettes, turrets and guns would be removed. Indeed, we rather suspect that the ships would be found to be too stiff for comfort; and their rolling in a beam sea would probably be jerky and therefore extremely unpleasant for the passengers. Furthermore, because the forward sections of the vessels are so fine, they would be extremely wet when driving into a head sea. The writer saw the "Lusitania," a fuller ship forward than the battle cruisers and with 10 feet more freeboard, bury her fo'castle deck out of sight when she was being driven to windward. What would happen to the upper works of these converted battle cruisers under like conditions? As battle cruisers, they would be immune against the impact, their barbettes, turrets, bridges, et cetera, having sufficient strength and inertia to withstand the blow. The battle cruisers were designed for 35 knots speed with 180,000 horsepower. Forty to fifty thousand horsepower would suffice to drive them at 24 knots.

Port Authority and the Hudson River Bridge

THE Port Authority was formed for the purpose of making a comprehensive survey of the problem of freight and passenger movement at the Port of New York and coordinating the efforts of the States of New York and New Jersey to this end. The recent report of the Port Authority shows with what painstaking care this vast problem has been investigated; and with one or two exceptions, we are able to give the report our cordial endorsement. We take exception, however, to the automatically operated tunnel as being altogether inadequate to meet the situation and as costing a sum of money out of all proportion to the benefits secured. We take exception also to the statement that although there is a call for a Hudson River bridge for vehicular traffic, there is no such demand for the provision of railroad tracks to enable freight and passenger trains to enter Manhattan.

Looking broadly at the problem, we hold today, as we have held for years past, that the first and most pressing step to be taken is to join Manhattan Island, which is the business heart of this district, with the rest of the United States. This, of course, is only part of the problem; but it is by far the greater part, and it can be solved at a stroke by the construction of a great highway and railroad bridge of the type which within the next few years will be erected across the Hudson River. The Port problem is so big that it is folly to play merely with it by the construction, now and then, of a tunnel of limited capacity, such as is proposed by the Port Authority. It would take twenty tunnels to equal the one bridge in capacity; and they would cost two and a quarter times as much.

The problem is one of handling passengers, heavy freight, and light, small-package general merchandise.

The Port plan makes no provision for bringing long-distance and commuter passengers into the city. It lands them on the Jersey shore, and leaves them to make their way as best they can, by tunnel or ferry across the Hudson River. The bridge will bring the long-distance passengers into a union station in the heart of the city, and will enable commuters from New Jersey to move from their homes to the downtown districts without a change of cars.

The Port plan proposes to abandon the waterfront of Manhattan as a location for the transfer to steamships of heavy freight coming in from the southwest and north, and substitutes the Jersey waterfront in its place. The bridge, with its twelve railroad tracks and its classification yard in the Jersey meadows, provides for bringing heavy freight in carload lots across the bridge and into Manhattan, where it can be unloaded direct to steamships at the docks or into its line of warehouses extending down West Street.

The Port plan proposes to handle food, clothing and general merchandise, or what is known as less-than-carload lots, by building a tunnel beneath the River and diagonally beneath Manhattan Island, and providing a series of warehouses throughout the city in which the material can be sorted either for immediate distribution or for storage. A system of electrically-operated trains without crews is to be employed. The system may be good; but it has never been tried on the ambitious scale which is here suggested. To that extent it is an experiment. Therefore, it would seem to be injudicious to commit the city to the expense of 200 million dollars which would be required to place it in full operation. The bridge scheme, on the other hand, proposes to employ a large fleet of motor trucks which, at a classification yard in New Jersey would load up with the merchandise and run directly across the bridge to the merchant warehouse or the store front to which the stuff was consigned. Furthermore, as regards heavy freight in carload lots, whether it is consigned to the city or for steamships sailing to foreign or domestic ports, the bridge scheme, instead of abandoning the Manhattan waterfront for such freight purposes, proposes to build a freight and passenger track down the length of West Street and house these tracks within a continuous stretch of warehouses, with communications extending across the street to the various piers. By this means, heavy freight could be either delivered direct to the ships or stored in the warehouses.

Germany Is Disarmed

WHETHER Germany has accomplished "moral" disarmament or not, there can be no question that she has carried out to completion the material disarmament demanded at the Armistice and at Versailles to completion. If today she were morally war-minded, and if she were not disarmed, the threat of war would still be present. But Germany, so far as any military operations is concerned, is so completely bereft of armament, that any military man, basing his statements upon the facts as they are and as they are known to be, will tell you that, for all her seven million men of fighting age, she is not only incapable, today, of military operations, but of necessity must remain so for a long period to come.

Modern war is an engineer's job. It is a matter of mechanical appliances produced on an enormous scale and wielded by a highly trained army of mechanicians. Destroy the mechanism of war and you have destroyed the possibility of war so far as a disarmed people is concerned.

Thanks to the Conference at Washington, we have laid the bugaboo of Japanese navalism. It remains for the Conference, or a similar one, to lay the bugaboo of an ever-present German militarism. The question is: Has Germany disarmed, or has she not?

The answer to that question is to be found in a review of the work of the Interallied Commission on Military Control, with headquarters at Berlin, which was printed in a recent issue of the New York *Times*, in which it is stated that both in respect to munitions of war and of establishments devoted to their manufacture, Germany today is from 90 to 95 per cent disarmed. Field and heavy artillery is too bulky for successful concealment; and we have noted that occasional official reports during the past half year have stated that all of the German war material of this character is accounted for. Of the celebrated *minenwerfers*, 11,579 have been surrendered, 11,489 have been destroyed, and 90 remain. Machine guns and rifles are, of course, easier of concealment; yet the surrender and destruction of these have been on an enormous scale, including 86,505 machine guns surrendered and 84,108 destroyed, with 2397 remaining. Of rifles and other small arms, 4,460,649 have been surrendered, 4,351,627 destroyed, and 109,021 remain. We are informed that this military disarmament has extended to field bakeries, field ambulances, field printing plants, armored trains, pontoons and bridging material, that it covers, in fact, everything conceivable to the military mind.

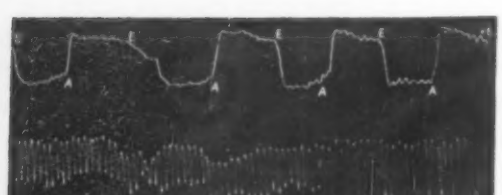
Not only has Germany surrendered or destroyed her finished military material; but of the 7000 manufacturing plants and factories which were known to have been engaged wholly or in part in manufacturing war materials, 5000, commencing with the great Krupp plant, have been de-militarized; and of the 2000 factories remaining, the majority are small and of very limited capacity. The Interallied Commission on Military Control has done this work of industrial disarmament so thoroughly that, in its opinion, fully two years would elapse before Germany could begin to supply munitions of war, even on a limited scale.

Shortly after the Armistice, we wrote in this paper that the very last thing the German people were thinking about was another war. We repeat that statement today, with a conviction which has been strengthened by the sweeping manner in which her disarmament has been carried through.

Where Human Speech Is Put On the Dissecting Table

The Remarkable Laboratory of Experimental Phonetics of Dr. Panconcelli-Calzia of Hamburg

By Dr. Alfred Gradenwitz



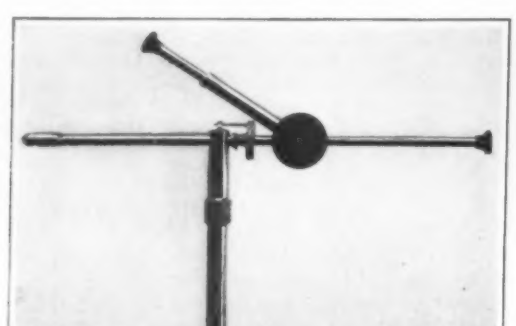
Sample speech-curves from the phonetic laboratory

WHAT is human speech? What are its component elements and how should any one of its varieties, any language, be studied and taught? Is it a cut-and-dry system of rules called grammar, governing (to some extent) its written record, literature? Can a superficial study of this artificial decoction, as commonly carried out at school, convey anything like an intimate knowledge of a foreign language? Or is it rather a living organism, something existing and growing and decaying in millions of human minds, throbbing in millions of human hearts and finding its immediate, its foremost expression, not in the literary products of a few, but in the mouths of millions of human beings? The science of phonetics has developed a growing propensity toward the latter viewpoint.

Though this youngest branch of linguistic science be at the same time an invaluable aid to the medical practitioner (deriving additional knowledge on morbid processes), to the psychologist (studying the mental make-up of languages), to the actor and public speaker (intent on perfecting his elocution), and to the teacher of deaf-mutes and those affected with some other defect of speech, there is but a limited number of places where experimental phonetics can be studied from some special point of view, and there is perhaps but one place in the world where this study can be carried out in the universal rather than a specialist spirit: the Laboratory of Experimental Phonetics of the City of Hamburg.

This unique institution is under the direction of Prof. Panconcelli-Calzia, a "Roman of Rome," who, after studying at German and French universities and working with the pioneers of phonetic science in both these countries, was appointed to take charge of the newly founded Phonetic Laboratory for African Languages of the City of Hamburg. Under his care this soon outgrew the limited space at its disposal (occupying an entire building, instead of a single room as in the beginning); just as rapidly it outgrew its original scope, until it now embraces the whole science of phonetics and its applications, in place of the mere phonetical elements of a given group of languages.

The laboratory building is situated in the center of Hamburg, though in a quiet neighborhood, close to the remaining State laboratories, the Botanical Gardens and the old cemeteries. It comprises four stories with 23 rooms, of which 16 are used for experimental work. The architecture as well as inner appointments are both practical and in accordance with modern fashion. The basement is mainly set apart for X-ray work, ordinary photography and photographic voice recording. The main floor is mainly destined for instruction, though at the same time available for scientific work. The first and second floors comprise in addition to rooms for phonographic recording and reproduction, microscopic examination and the storing of records. The director is assisted by a machinist, two mechanicians, a laboratory servant and other manual helpers as well as by several volunteer assistants (at the moment under review a singing-mistress, a linguist, a medical specialist and a teacher of deaf-mutes). On account of the wide range of work covered by the laboratory, there is a growing specialization into different departments, those already formed comprising a Phonetic X-ray Department, a Cinema-Phonetic Department and a Phonographic Central Station, all of which have for some time been supplying new material by scientific research work, as well as collecting and classifying the available material and giving out both scientific and practical information. The work of the laboratory is ably assisted by the publication of an international magazine, called "*Vox*," and which, under the joint editorship of Dr. Panconcelli-Calzia and Dr. H. Gutzmann, constitutes the literary center of the young science of phonetics, publishing accounts of the best work done in all countries.

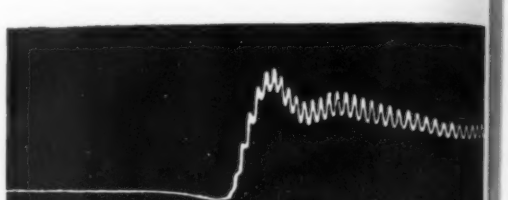


The autophonoscope, with which the subject and the investigator are able simultaneously to see the vocal cords in vibration

As regards methods used by experimenters in phonetics, it should be remembered that even the mere observation with the unaided ear, eye and sense of touch will supply a wealth of valuable data. The ability of discerning sounds, of course, varies within wide limits from one person to the other and can best be tested by means of phonograph records; many persons, especially deaf-mutes, with or without a special training, have a surprising facility for lip-reading, and the touch enables sound vibrations to be distinguished with relatively high sensitiveness.

A sound recorder for phonetic research

Far more accurate results are, however, obtained by resorting to special apparatus for examining sound phenomena. Some of these are for visual observation without any recording devices. The working of the larynx, the main organ of human voice, is, for instance, with remarkable ease examined by means of Dr. Panconcelli-Calzia's autophonoscope. This comprises a tube one end of which is introduced into the mouth, the opposite (eye-piece) end being intended for the experimenter. The person experimented on (or the pupil receiving a lesson of phonetics) sees his own vocal organ in the branch tube. The main tube contains a half-transparent mirror. The instrument also comprises a lamp and sometimes a lens system. The most conspicuous advantage of this instrument is that both the experimenter and the person experimented on simultaneously see the working of the vocal organ.

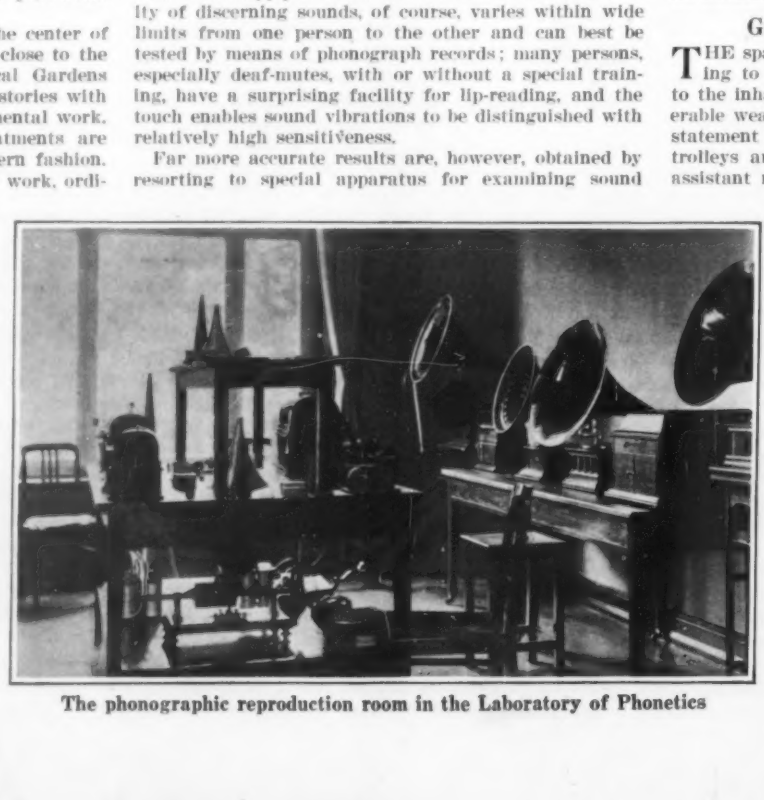


A speech-curve of somewhat different character

An apparatus taking records of the sound vibrations constituting the human voice is the laryngograph. This comprises a small metal box coated with a taut rubber membrane and fitted with a tube as well as an adjustable recording lever. The person experimented on keeps against the thyroid cartilage of his vocal organ (larynx) a capsule communicating through a leather tube with the laryngograph just described, and transmitting to it any vibrations of the sounding air-current. The recording lever accordingly traces on the rotating drum coated with blackened paper a curve characteristic of the sound vibrations.

Another apparatus in addition to vibrations also records impulses. Its recorder is coated with a loose membrane and provided with a very mobile recording lever responding to the slightest impulse. A funnel is used as receiver. Sounds are reproduced in the form of straight or curved lines, partly sinusoidal curves similar to those of the laryngograph.

A great advance on existing methods has recently been made by Prof. Panconcelli-Calzia and his colleague, Prof. J. Hegener, by resorting to cinematographic as well as to stereoscopic records of the vocal organ, so that all the details of the latter are seen with remarkable plastic effects, as well as in the course of its natural motion.



The phonographic reproduction room in the Laboratory of Phonetics

Greasing Electric Trolley Wires

THE sparking of the trolley wheel is not only annoying to the motorman and the passenger as well as to the inhabitants at night, but it is a cause of considerable wear in both trolley wheel and wire. The same statement is largely true of mining operations where trolleys are used. According to the statement of an assistant mine inspector of Kentucky, by greasing the trolley wire with a hard conducting cheap grade oil, the wheel may be caused to operate without sparks or flashing without any considerable extra expense. The singing of the wheel can not be heard when the grease is used, and the practice also saves the wear on the trolley wheel. It is said that one new wheel on greased wire will outlast a dozen on dry wire. Furthermore, it gives perfect contact and so saves power, especially on a heavy grade, and prevents sleet from accumulating on the wire. One greasing will serve under ordinary use for five or six months.

The Right of Way

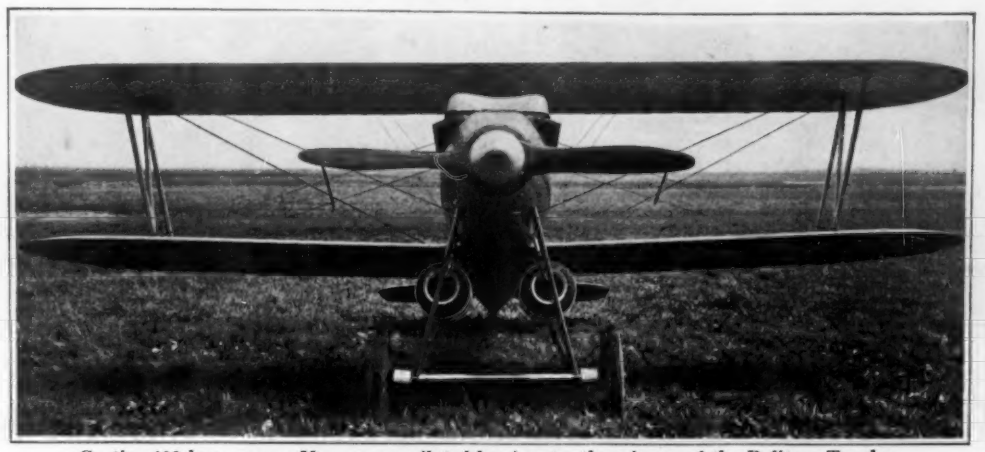
BRITISH motoring papers are conducting a discussion of the intersecting road problem. The granting of precedence to the car on the right impresses the British mind as confusing. In its place it is proposed that the vehicle on the main road have right of way; and that when neither road is a main one, one or the other be made so by convention!

Airplane Racing and What It Means

The Immediate Lessons to be Drawn from the Pulitzer Race at Omaha

By Howard Mingos

WHEN Bert Acosta piloted the Curtiss Navy biplane across the finish line in the Pulitzer Trophy Race at Omaha, Neb., November 3rd, he had covered a course of 153.59 miles at an average speed of 176.7 miles an hour —about 260 feet a second— and had broken all records for speed over a closed course. That particular Curtiss entry had torn through space an average of 3.7 miles an hour faster than the Nieuport-Delage "Sesquiplane" in which Georges Kirsch had won the first Deutsche de la Meurthe Trophy and created a new world's record at Etampes, France, October 1st.



Curtiss 400-horsepower Navy racer piloted by Acosta, the winner of the Pulitzer Trophy

The Pulitzer Trophy course this year was triangular and included twelve, eleven and seven mile straightaways. This made five complete laps in the race. Acosta told the writer that on the twelve-mile straightaway, with the breeze, he had made a speed of approximately 230 miles an hour, despite the fact that an intermediate flying wire, one of the most important wires in a plane, had snapped before he had finished the first lap. This gave the daring pilot some difficulty in rounding the pylons at each point on the course; nevertheless he kept the machine at full speed whenever opportunity afforded and during the entire race did not rise more than 500 feet from the ground.

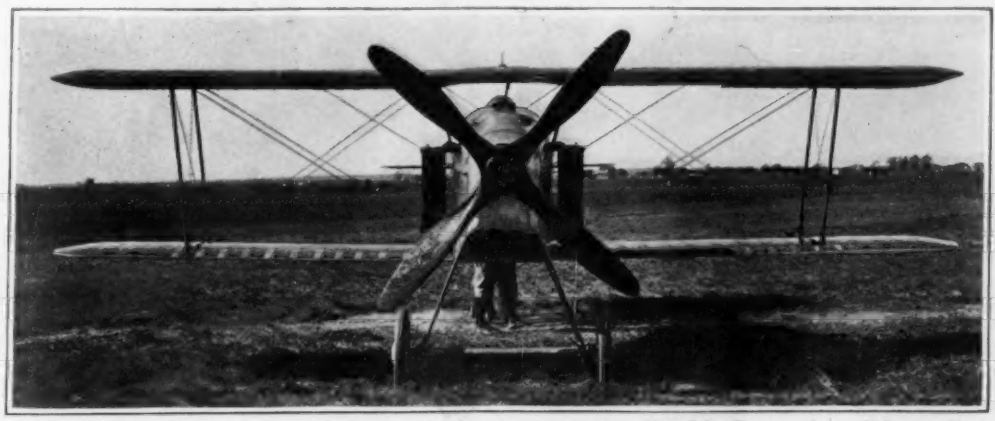
Thousands cheered themselves hoarse at the gallant performance of plane and pilot, which was not without keen competition. Clarence Coombs, driving the Curtiss-built "Cactus Kitten" for S. E. J. Cox, of Houston, Tex., who first entered the plane in the Gordon Bennett races in 1920, had an even chance with Acosta when the race began. Many believed the "Cactus Kitten" was the faster plane, faster, all points considered, by six miles an hour. Coombs, however, had never flown the "Cactus Kitten," and the plane itself had never been opened wide in a race. To the spectators it was apparent that Coombs was not able to get the most out of his machine in rounding the pylons, for he made wide turns at varying heights and probably traveled 25 miles more during the race than did the others. So great was the speed of the Curtiss-Cox entry, however, that Coombs won second place, averaging 170.26 miles an hour. Even at second, Coombs flew faster than any other had ever flown on this hemisphere.

Among the starters who did not finish was Hartney, who was wrecked. His start was delayed by trouble with the gasoline pump, and this failed again during flight, bringing down the plane and sending the pilot to the hospital. He told me that he was making more than 200 miles an hour when the same little piece of mechanism that had delayed his departure again failed him. He tried to use his emergency gasoline tank, but so great was his speed that he could not divert his attention even momentarily without going into a spin. He knew he must land, and picked the best field available, a grass-covered plot, which proved treacherous with a slough running clear across it. Into this the plane crashed while running over the ground at a hundred miles an hour. Hartney was thrown clear of the wreckage. Now it was not motor trouble nor defective design in the plant that brought him to earth. The Wright motor, similar to that with which McCready won third place, functioned perfectly as long as it was fed with gasoline. It was the accessory, the gasoline pump, which defied the efforts of the Wright experts, who had labored with it all day to guarantee success.

The Curtiss racer "Cactus Kitten," owned by S. E. J. Cox of Houston, Tex., and piloted by Coombs; perhaps the fastest machine in the race, but condemned to second place by unmanageability on the turns

That, and the fact that races in the air or on the ground are by nature, if they are real races, calculated to test to the limits—often past them—the endurance qualities of ordinary transport. That is the chief value of races—to test the capacity of all mechanical qualities. That is the practical side of sport. It is the sportsmanship displayed by racers which sets an example to the crowd. And it is this lack of sportsmanship, or rather, a retarded development in national consciousness, that so far has left to the few the task of developing American aviation. The makers of planes, as well as the pilots, are doing their share. That was demonstrated in the Pulitzer race.

But races should not be conducted without all precautions being taken. There should be provisions for forced landings. Race courses should be over available landing fields, emergency or temporary. There were few entries in the Pulitzer race because it was not scheduled earlier. Months are required for the design, construction and tests of record-breaking planes. And there is little value entering planes unless they have a chance of winning. One of these days the public may be sufficiently versed in aviation to look upon the airplane as it now looks upon other vehicles, not as a curiosity to be picked to pieces when it is brought to earth temporarily helpless. And one day, if present indications justify the prophecy, we all shall fly at varying speeds of 176 and 230 miles an hour. Even today American designers are working on plans they confidently trust will produce machines which next year will break all records.

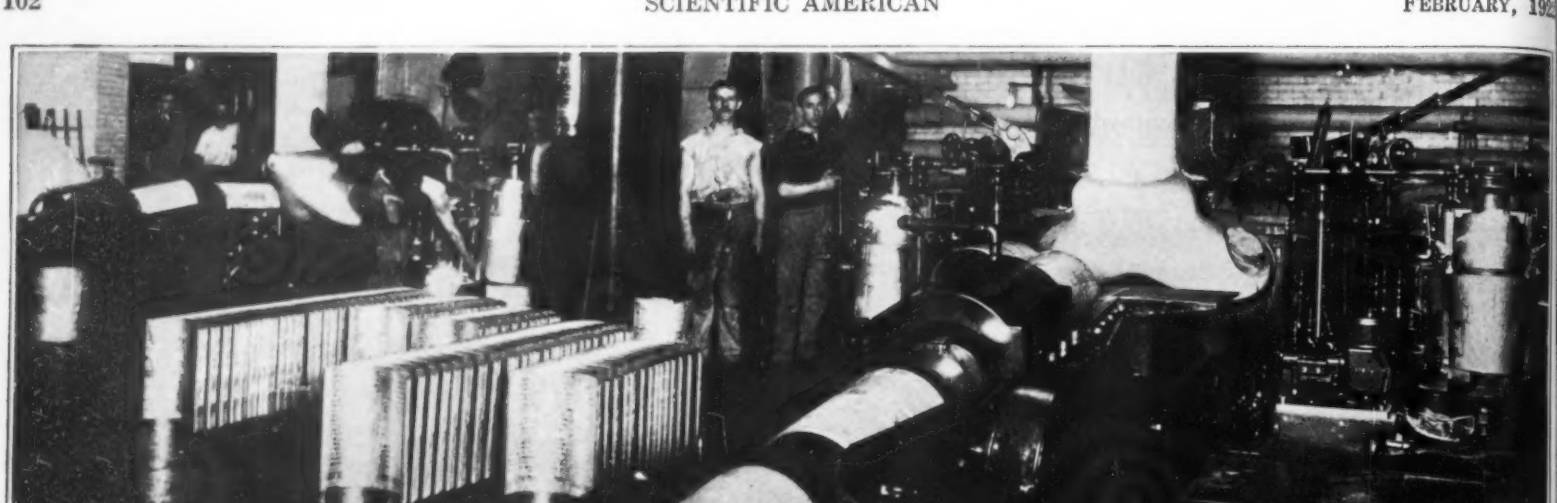


The S. V. A. Balilla racer with Curtiss 400-horsepower motor piloted by Bertraud; an "also ran"

New Process of Piloting Ships by Sound

THE piloting of ships by means of an electric cable was one of the clever inventions of the war. The process is, however, rather expensive and necessarily fidently trust will produce locality. It is now proposed to make use of sound waves to enable pilots to estimate their distance from land. By means of the special apparatus known as hydrophones the sounds made by explosions can be heard at great distances. A bomb weighing 100 kg., for instance, can be heard to detonate at a distance of 300 km.

When a ship employing this new process is approaching land it throws a grenade into the sea and at the same time emits a wireless signal. The latter is at once registered by a recording apparatus installed at the listening post. The noise of the explosion is also recorded, but only after the lapse of a certain interval of time, which, of course, depends upon the distance. If there are two listening posts on the shore, their respective distance enables the pilot to determine the exact position of the boat. This method has been found to give results more precise than those obtained by radiogoniometric measurements. It is especially valuable in time of fog. During the war it was employed by the English monitors in bombarding the Belgian coast, which was invisible, in order to determine their exact location. The *Revue Scientifique*, to which we are indebted for these facts, predicts that listening posts of this sort will soon be in operation in England, France and Algeria.



The autoplate machine turning out stereotype plates in a daily newspaper printing plant

How an Inventor Straightened Out a Labor Tangle

One Case Where a Labor-Saving Machine Went Into Use Without a Conflict With the Men

By James H. Collins

THE technical problems solved after five years' work, and the machine running. A great market waiting, and the first customer ready with his money. The invention finished and successful—but a labor difficulty standing in the way of its introduction.

Many inventions must bring a shifting and displacement of workers. This was that kind of invention—the autoplate, an automatic device for making stereotype plates used in printing newspapers. And this was the situation facing its inventor, Henry A. Wise Wood, some twenty years ago, when his first machine was ready for delivery on contract.

The labor problem is human, and so are inventors, usually. This inventor had the characteristic, and the problem was solved by straightforward human dealing, man to man.

If there was ever a period during his boyhood when he was not familiar with the mechanism of printing, Mr. Wood doesn't remember it. As a youngster he had his printing press, and later published the school paper. In studying engineering after that he had a definite purpose—to improve the printing art.

"At its opening, the nineteenth century boasted hand-made type, set by hand, and a wooden-screw hand press capable of printing two hundred 'sides' an hour," he says. "At its close, it had huge establishments turning out daily issues of many-paged newspapers well up in the hundreds of thousands of copies, printed by machines of incredible swiftness and accuracy. The twentieth century opened with a still greater demand for printing speed."

His first investigations were made in the field of book printing, but he quickly saw that the newspaper was the greatest vehicle for conveying information to the masses, and centered his attention upon newspaper manufacturing. A son of Fernando Wood, mayor of New York City in the fifties, he knew James Gordon Bennett, publisher of the *New York Herald*, and got permission to study the technical side of newspaper making in that journal's plant. The manufacture of newspapers, he found, involved three mechanical departments—the composing room where the type was set, the stereotype room where the printing capacity of the type was multiplied by casting from it curved semi-cylindrical printing plates, and finally the press room. In the composing room such inventions as the linotype and monotype had substituted machine for hand labor, and in the press room there were giant perfecting machines that automatically turned out newspapers at the rate of 15,000 to 24,000 an hour. But stereotyping was still entirely a hand process. The papier-maché matrices were made, the hot type-metal poured, the castings cooled and trimmed by skilled mechanics, aided by practically no labor-saving devices. A newspaper like the *Herald* at that time required 400 stereotype plates for its daily edition, and 1700 for the Sunday issue. To make them, a great many stereotypers were employed. Between the final locking up of the type pages and the starting of the presses an hour and a half was required to make the plates and begin printing, where today, by means of this stereotyping machine, the whole battery of a great newspaper's presses is working in ten to fifteen minutes after the type forms are closed.

"The stereotyping department was like a single-track bridge connecting two sections of a four-track railroad," is the way the inventor expresses it, "and everything involved in the making of a newspaper had to be crowded over that bridge."

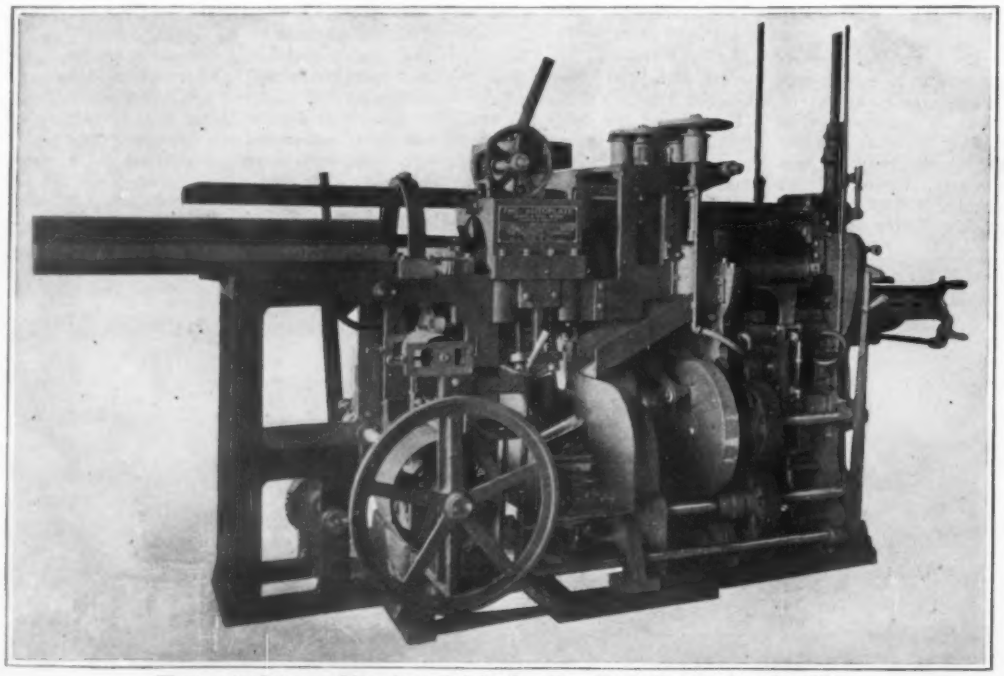
After some weeks' study of the different operations necessary in making stereotype plates by hand, he was confident that a machine could be built to do the work—so confident that he went to Mr. Gardner I. Howland, business manager of the *Herald*, with estimates of the time that could be saved by such a machine. The newspaper man was interested at once. For already publishers vaguely sensed the remarkable expansion of both circulation and size that would be brought by the world war, and the need for machinery to meet it.

"What do you want me to do?" Mr. Howland asked.

"Give me an order for a machine," was the reply.

A contract was made, the *Herald* agreeing to accept and pay $25,000 for a stereotyping machine, provided it made satisfactory plates, while the inventor was to bear all the cost of building such a device, and get nothing if it proved inadequate. Wood fitted up an experimental laboratory, hired machinists, and went to work in secret on the problem. It took five years to build the first autoplate, bringing it to a capacity of four stereotype plates a minute—later increased to eight. Two different sorts of mechanism were needed, one for the automatic casting of the plates and the other for trimming them to fit the cylinders of the presses.

When the device was ready for demonstration Mr. Howland was fascinated by its working—and also a little scared. There had lately been a strike over the installation of the monotype machine in the office of the *New York Sun*. This had been harmful to that paper. Mr. Howland was afraid that labor trouble would follow the installation of the stereotyping machine in the *Herald* plant. This contingency had been foreseen by Mr. Wood and provided for in the contract, with the agreement that the *Herald* was to deal with any labor difficulty that might arise. When James Gordon Bennett was told that the new device was ready and that the labor difficulties were now up to him, he was even more apprehensive.



First autoplate machine, installed in the *New York Herald* plant in 1901

"I have done my work and carried out my part of the contract," said the inventor when Mr. Howland demurred at putting the machine into use. "Here is the machine. Most of my money is tied up in it. It is built to the *Herald's* page size, and can not be used by another newspaper. What are you going to do?"

Face to face, the difficulty looked formidable. Howland could only suggest that the matter be settled by Mr. Bennett, who was in Paris. The prospect of negotiating such a situation by cable was not very promising. After some discouragement and delay, Wood volunteered to shoulder the difficulty

himself, to the relief of both Howland and Bennett, who then agreed to accept and pay for the machine if it could be installed without labor trouble.

The inventor's first step was to let the New York stereotypers' union know, indirectly, that a machine to make newspaper stereotype plates had been perfected. This report made a stir among the stereotypers, who held a meeting and appointed a committee to get such information about the device as was obtainable. The only person who had seen the machine at that time, apart from the inventor and his workmen, was Mr. Howland. The committee of stereotypers believed that any information they secured would have to be got in roundabout ways. As soon as he heard of this action Wood wrote to the stereotypers' organization, saying in substance:

"You have heard that a machine has been invented to make stereotype plates automatically, replacing hand labor. The rumor is true. I am the inventor of the machine, and should like to meet your investigating committee."

The committee came to see him, and they had a very frank talk.

"Gentlemen, this is an age of machinery," said the inventor. "Work like yours, done by hand, is bound to be brought into the machine field sooner or later. I have invented the machine to do your work. If I hadn't done so, somebody else would have invented it. It is a machine that may displace large numbers of workmen at first, but like all other devices of the kind, it will eventually make a greater demand for labor. There is no case on record of workmen opposing machines by strikes, or otherwise, and winning against them. The machine always wins in the end. When there is a strike, there must eventually be a compromise. So I thought we might get together at the beginning and see if we couldn't have the compromise without the strike. The success of my machine depends partly upon yourselves. Take plenty of time, discuss matters, and let me know what suggestions you have for installing my machine on a basis that will be fair to yourselves as well as the *Herald* and me."

The stereotypers went away impressed by the inventor's frankness, as well as the force of his argument. After another meeting of the union the committeemen asked if they might see the machine. The request was granted. When they saw delicate stereotype printing plates turned out five times as fast as they could be made by hand they were apprehensive, naturally. But fear of losing their jobs was mingled with admiration for mechanism that did their work—there could be no better audience for such a machine.

Suddenly one of the committeemen propounded a question: "What are the men operating this machine—stereotypers?"

"No, they are machinists; not one of them has ever been in a stereotype room."

"Could machinists operate this machine, then?"

"Certainly—it has never been operated by anyone else."

"What do you pay your machinists?" asked the committeeman, and when told that they got $2.75 for an eight-hour day, it was obvious to the visitors that possible rivalry with another trade was a factor in the situation to be dealt with. For stereotypers were then getting $4.50 for six hours' work. The new machine could be both installed and operated by machinists, without stereotyping experience, at a little more than half the wages.

These meetings continued over several months, and finally out of the discussions grew an arrangement with the stereotypers' organization whereby the autoplate was to be installed in the *Herald* office, and operated by *Herald* stereotypers. Three men were enough to run the machine, but it was agreed that five should form the first crew. As money savings were effected for the *Herald*, it was agreed that the stereotypers should share in this economy. Moreover, the union made changes in its constitution that amounted to adopting the machine—the inventor believes this to be the first case in history of a union taking under its protection a new labor-saving invention. Should other newspapers want to install it, the union delegated two of its members to go into an office where the autoplate was working, and there learn its operation, being paid by the union. Members also agreed that they would operate the machine in ways to make it efficient, keeping it in good repair and condition.

Against the inventor's judgment, a steel fence had been built by the *Herald* around the machine when installed in the *Herald* office, and a sign forbade entrance except to the men actually working with it. Under Wood's supervision, work was taken gradually from the hand stereotypers, the autoplate making only a half dozen plates the first few nights, then a dozen, and so on, until at the end of several weeks it was turning out more than half of the work. During that time the inventor was in the stereotype department every night, and became acquainted with every man personally. There was good feeling and confidence on both sides.

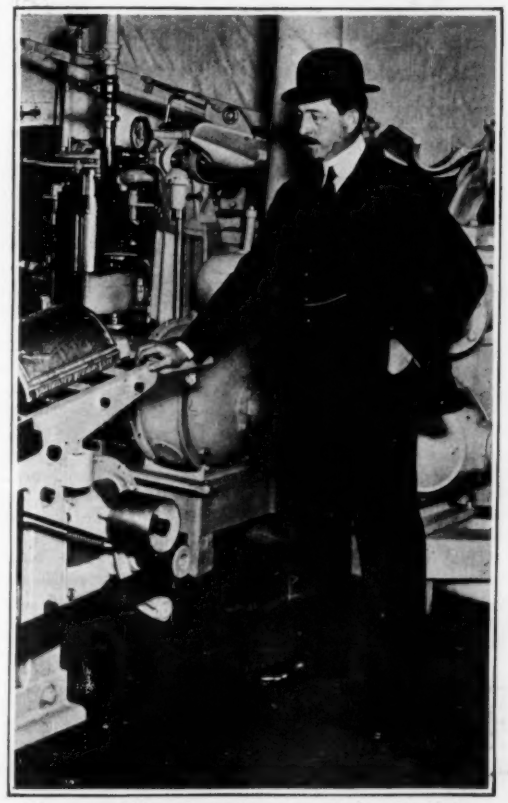
One evening, coming in about 10 o'clock, with his mechanical assistant, Wood walked into the cage and turned up the lights—only to turn them out again almost instantly. For one glance showed that his machine had been damaged. With a single lamp, guardedly they went over broken gears and working parts showing too plainly where they had been pounded with a heavy sledge. When a list of the broken parts had been made, the light was turned off.

"We must replace those parts and have everything running again tomorrow night," said the inventor to his assistant. "Phone the shop and start work at once."

Presently, stereotypers were coming in to work. The dark, locked cage attracted immediate attention. The machine had been jokingly dubbed the "iron horse."

"Why, what's the matter with the iron horse?" was asked.

"It isn't working tonight," Wood replied. "We had an accident on that last run this morning, and broke some of the gears. But we'll be all right again to-



Henry A. Wise Wood, inventor of the autoplate, demonstrating the working of the machine

morrow. Machinery will break down once in a while—I think we've been pretty lucky so far."

Fortunately, the *Herald's* stereotype force was still large enough to make all the plates required. One of the *Herald's* men was president of the union. After the paper had gone to press, Wood took him aside for a talk. He had already sensed something more serious than a breakdown. Who did the damage never transpired, but it was undoubtedly the work of outside hotheads. Wood was confident that none of the *Herald* men had done the job, but pointed out to the union official that the machine must be protected. Should the *Herald* hire guards, or would the stereotypers themselves undertake this responsibility? The union official pledged the protection of his men.

The next morning Howland sent for Wood and showed him copy for an advertisement to be printed in the *Herald*, offering $10,000 for information leading to the conviction of the stereotypers who, Mr. Howland said, had damaged the machine. This offer had been cabled from Paris when James Gordon Bennett learned of the trouble. The inventor insisted that the advertisement be suppressed, and as he was in charge of the labor situation, his wishes were respected. At first Mr. Howland refused to do it, saying that he must find the members of the *Herald* crew who had done the damage. To this Mr. Wood replied that he himself would vouch for the fact that the *Herald* men were straight, loyal fellows who would not commit such an act.

"Leave the matter to me and forget it," finally said Wood to Howland.

"All right," assented Howland.

"Now, will you do me a favor?"

"What is it?"

"Take down that cage today, and the sign—I don't like them."

"What? I was going to put a police guard in it tonight! However, if you will take the responsibility, I'll pull down the cage."

"All right," said the inventor.

News of this advertisement and its suppression were not long in reaching the *Herald* stereotypers, who that night came to the inventor to thank him for intervening to save them from the suspicion such an advertisement would have cast upon them. The steel cage was taken down, and all were invited into the enclosure.

These steps improved good feeling to such a degree that there was never any more damage or trouble. Stereotypers saw that the autoplate was not a makeshift but a practical device. It had been pointed out to them that it would lighten their hot, heavy work, enabling them to use their mechanical skill and their heads to better advantage, becoming supervisors of machinery instead of working as machines themselves, and increasing their output and earning capacity. These promises were now realized. This union had always had excellent relations with employers, and was proud of its foresight in helping make the transition from hand to machine work instead of opposing it. In a few weeks all the *Herald's* stereotype plates were being cast by machinery, and delegates of stereotypers from other newspapers were working to acquire the experience needed to make the same transformation elsewhere.

There was practically no loss of employment. The growth of the *Herald's* work was so great, because of this machine, which made rapid publication so easy, that in a short time more stereotypers were employed in the *Herald* office than ever before. Once when a visitor asked the foreman how many men would be required to produce by hand the 2300 plates being made that night by 18 men, he calculated that it would require 75 at least.

From that day to this there has been only one strike against the autoplate, which occurred when the machine was first introduced in Europe. On that occasion the inventor went abroad and settled the difficulty in a few hours. He was invited to do this by union officials on the other side, and carried a letter from the stereotypers in this country.

When the first autoplate was installed in New York the stereotypers' union had about 200 members. Today it has 650 stereotypers and finishers at work, in addition to 350 electrotypers, a striking illustration of the fact that labor-saving machinery ultimately does increase employment by increasing output. Any prospect of going back to hand drudgery would be vigorously opposed by stereotypers themselves. In the old days a newspaper stereotyping room on hot summer nights came as near being an inferno as the stokehold of a steamer going through the Red Sea. It was nothing unusual for three or four men to be overcome by heat every night. Burns and strained muscles were common, and so was poisoning by lead and antimony fumes from the type metal. Today the "iron horse" does all this hot, heavy work automatically, casting stereotype plates from metal heated to 600 degrees, against the 750 degrees necessary in hand casting. Instead of lifting hot metal and plates, machine operators simply pull levers, and a newspaper stereotype room in summer is now as cool and pleasant as any other department of the plant. So this invention besides being useful was merciful as well.

Alfalfas

As a result of investigations, an account of which is contained in the *Journal of Agricultural Research* for July 15, 1921, Messrs. R. A. Oakley and H. L. Westover, of the Bureau of Plant Industry, Washington, D. C., conclude that it is the day-night relation of alfalfas and not their reaction to temperature that causes the development of marked differences between the seedlings of the various varieties when seed is sown at certain times of the year. By the proper control of the length of day, which can be accomplished in the greenhouse at any time of the year with little trouble or expense, and by the method used in the authors' experiments, it is easily possible to distinguish between seedlings of the commercial groups of alfalfas. The tests can be so quickly and easily made that the method is offered especially to Experiment Station workers and those engaged in alfalfa-seed certification work as a means of assisting in the identification of the various lots of seed.

Corrosion Investigations

Some of the Controlling Factors, and How Account Is Best Taken of Them

By D. M. Strickland

ANY experiments which result in a better understanding of the influences governing the corrosion of iron and steel are of great value, not only to manufacturers, but to users of ferrous metals as well. Testing societies, governmental laboratories, research organizations, and interested individuals are continually investigating this problem from many angles.

There is no doubt but that the corrosion resistant properties of the many present-day commercial grades of iron and steel differ widely when subjected to the various conditions of commercial requirements. Chemical purity, degasification, scientific annealing, freedom from slag inclusions, proper application of protective coatings, and exacting care in all stages of the manufacturing process are factors which undoubtedly tend toward the production of the most satisfactory corrosion resistant product.

From time to time non-technical investigators desire to conduct tests under their personal observation. These notes are submitted as an aid to their study and contain suggestive procedures for corrosion test investigations.

Scientifically controlled corrosion investigations are valuable indicators of the service life of ferrous metals. It is essential, however, that all tests be carried out under exact uniformity of test conditions. This is true for both atmospheric investigations and accelerated laboratory immersion tests. All grades of material under test must receive the same preparatory treatment and be subjected to like conditions.

The following paragraphs do not in any measure tell the whole story of corrosion test conditions, yet they will be of value, in that they bring to attention many essential factors.

An atmospheric corrosion test is usually conducted in the following manner: The full size sheets which are chosen are uniform in length, width and gage. Sections of sheets are not recommended for outdoor tests, as the results obtained on small samples are nonconclusive and open to question.

Usually several sheets of each grade are used for the test, so that when the results are obtained, such results will be averages and not single instances. Flat sheets can be used, but in order to stiffen the sheets it is customary to corrugate all specimens uniformly.

The sheets are securely nailed to a wooden rack which has been erected in an open space in such a manner that the entire test will be equally exposed.

After the sheets are in readiness and the rack prepared, all sheets should be nailed in place at the same time. It would not be satisfactory to place one grade on the rack and then wait a few days to place the remainder. The angle at which sheets are exposed varies from 15 to 90 degrees. In choosing an angle it must be remembered that the less the angle the more severe are the service conditions. After choosing the angle, all sheets must be exposed with the same degree of slope.

In deciding on the locality in which to conduct the test, several points must be considered. If the test is started in a congested manufacturing district where the sheets are exposed to air laden with smoke the atmosphere will be contaminated by the products of combustion and will be an "acid atmosphere." Such was the air condition surrounding the Pittsburgh tests as conducted by the American Society for Testing Materials. In such atmospheres the conditions of service are far from normal, and so unusually severe that all grades of material will fail comparatively early. Such acid conditions are further indicated by the fact that incrustations of ferrous sulfate will appear on the sheets after exposure.

In a rural community where the air is pure the entire test will run several years before failures are obtained. Also, in sea air, where test conditions are again entirely different, the service life of the sheets under test will not be comparable with results obtained in "acid atmospheres or in air free from active reagents.

A large number of samples undergoing immersion tests for corrosion

With reference to the coating protection to be applied to the commercial sheets chosen for atmospheric tests, galvanizing is recommended. Bare, uncoated sheets were used for the Pittsburgh test as above mentioned. This was unfortunate in that the results obtained have so limited an application. The number of actual service installations where bare, uncoated sheets are used is trivial. Since tests should simulate actual service conditions as near as possible, the choice of coated sheets for atmospheric tests is most desirable.

To insure uniformity of conditions in immersion test investigations all variables in any way relevant must be considered. The following are important:

All test specimens must be uniform in gage and size. Samples 16-gage, 2 x 2 inches, are recommended as convenient gage and size, although other measurements will answer quite as well, provided uniformity is maintained.

All samples must be free from grease, oil, rust, dirt, scale, mechanical injuries, surface irregularities, excessively deep stencil marks, etc. To remove scale all specimens should be uniformly pickled in concentrated hydrochloric acid, washed well, and dried.

Temperature conditions must remain constant. The samples should be carefully weighed, vertically placed in separate tumblers and completely immersed in equal solution volumes, say, 300 cc. for each specimen. The entire test should be started at the same time. Any tendency toward unequal evaporation of the corroding liquid must be eliminated. All experiments must be conducted at least in duplicate (triplicate is even better), and weight losses of each grade should agree closely.

Great care must be exercised to guard against exhaustion of solution strength caused by the nature of the chemical reaction. It is necessary to remove the test pieces at proper time intervals and replace same in equal volumes of freshly prepared corroding media.

When it is desirable to discontinue the test all specimens must be removed from the solution at the same time, washed well in running water, scraped free from adhering particles, dried and weighed. The corrosion losses are usually reported as loss in grams per square meter, or ounces per square foot of actual surface exposed.

The investigator has an unlimited field from which to choose the corroding medium. By way of example, solutions of the following chemicals might be mentioned:

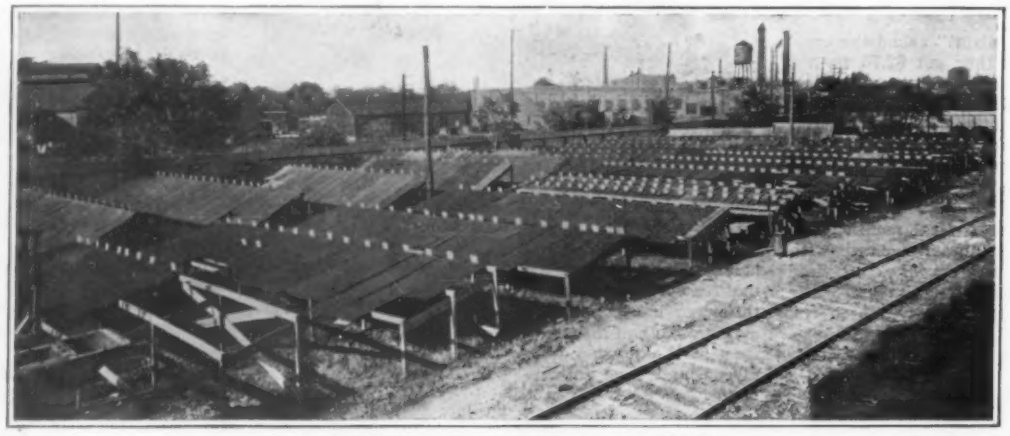
Ammonium nitrate, acetic acid (vinegar), hydrochloric acid, ammonium persulfate, sulfuric acid, aluminum sulfate, and acidulated ferrous sulfate. Among the many examples where ferrous metal installations are subjected to such immersion conditions might be mentioned the dyeing industry, paper making, coal-mine equipment, manufacture and use of vinegar, chemical plants, sewage-disposal systems, various acidulated waters, water-purification plants, etc.

The desirable strength of a given corrosive solution, and the best period of solution change, vary for different solutions. Aluminum nitrate should be in a 3 per cent solution and should be changed every three days. For other solutions the corresponding figures are: acetic acid, 3 per cent and 5 days; hydrochloric acid, 38 per cent and ½ hour or 20 per cent and 2 hours; ammonium persulfate, 10 per cent and 24 hours; sulfuric acid, 5 per cent and 48 hours; aluminum sulfate, 20 per cent and 4 days; ferrous sulfate acidulated with 0.7 per cent sulfuric acid, 1 per cent and 24 hours.

Immersion tests yield very valuable data when scientifically conducted as here outlined. The test-variables as numerated are essential. To neglect any condition of uniformity means that misleading results are obtained. Yet they are not so technical but that a careful investigator who is desirous of obtaining true results can easily follow them to a successful and reliable conclusion. It is obvious that the big danger of immersion test investigations lies in the fact that carelessness or lack of definite knowledge results in test interpretation of a nonconclusive or contradictory character.

When immersion tests results are published, a full report of testing details should accompany such reports in order to insure the knowing reader that all immersion variables have been considered.

An interesting factor in immersion test investigation is the increasing use of the single solution-volume. A large tank contains all the samples under test and is so constructed that the samples hang on a glass rod without touching each other. The corroding solution can be agitated, aerated, drawn off, changed, analyzed, etc.



Atmospheric corrosion tests of metal sheets

Changes of Temperature Curl Concrete Roads

IT has been recently found, in the course of experiments by the U. S. Bureau of Public Roads, that the edges of concrete roads curl up and down in response to changes in temperature. The unequal expansion and contraction of the upper and lower sides of the concrete slab under the influence of heat cause this curling. At the time of day when the surface of the road becomes the hottest it expands more than the cooler under side and the sides move downward. At night, when the edges cool, they curl upward.

The "Rain-Drop" Auto

By Eric A. Dime

A NOVEL feature of the automobile show recently held in Berlin was the automobile illustrated herewith, which is in some respects a reversion to first principles of the "horseless carriage" type, while in others it embodies the latest aerodynamic data. The machine, which has been christened the "Rain-drop" auto by its designer and builder—Herr Rumpler, the well-known airplane constructor—has a minimum air resistance and is propelled by a motor of small horsepower compared to the size and type of car it propels.

The leading points about this new auto are given herewith. To begin with, the car as a whole is shaped like a rain-drop, which assumes a perfect streamline form—the shape of least resistance. This form has been carried out from the ground up. The chassis has it, as well as the body itself. This shape results in the elimination of much discomfort that is suffered by the passengers of the usual type of automobile, such as noise, heat and smell from the motor and of dust arising from the road.

The chassis is constructed of two wide pieces of pressed steel bowed like the hull of a boat. The front axle passes through the frame without touching it, and flexible springs connect the two. The unsprung masses, which produce swaying, are reduced to a minimum, while the spring-supported masses that stop it form the maximum weight. The result is that the body sways but slightly, while the wheels cling to the ground and bounce but little. Consequently there is very little wear on the tires and the car is extremely steady-riding. Since the main weights are located in one spot, the car, when turned out of its course, regains the road again quickly without tipping. The springs are very flexible. A theoretically perfect suspension is provided, while the placing of the seats between the axles minimizes by one-half the motion imparted by road shocks to these. The chauffeur's seat is in front, in the middle, just back of the front axle. He has a clear view of the road and can run the car much better than when he sits a considerable distance back from the front end as is usual. The variable weight—the passengers—being placed in the middle does not affect in the least the relative load of the front and rear axles, while the constant weight is located at the two ends, the chauffeur being in front and the motor block behind. These weights are always there when the car is running, and they keep the load constant upon the two axles. With the ordinary car the motor and transmission, as well as the chauffeur, are both in front, and thus the rear axle is but lightly loaded, while with this new car the loading of the front and rear axles is practically the same. As the driving and steering wheels are properly loaded, skidding is impossible in wet weather, while with the old style car this is a serious defect.

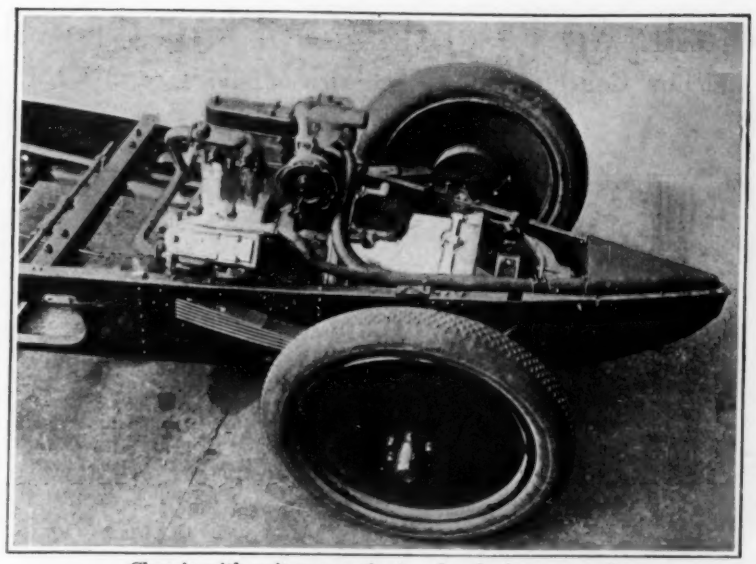
The motor, transmission, and rear axle form a unit which swings about the rear axle somewhat to allow for road shocks, etc. The number of parts is the lowest possible, great simplicity being obtained, and the length of the motor block being kept very short. The motor is a 6-cylinder, water-cooled one of the Y type, with a third pair of cylinders vertical in the middle of the Y.

The center of gravity is about 70 mm. (2¾ inches) lower than with much heavier cars of ordinary construction, whereby the stability is increased very greatly and curves may be taken without danger at high speed.

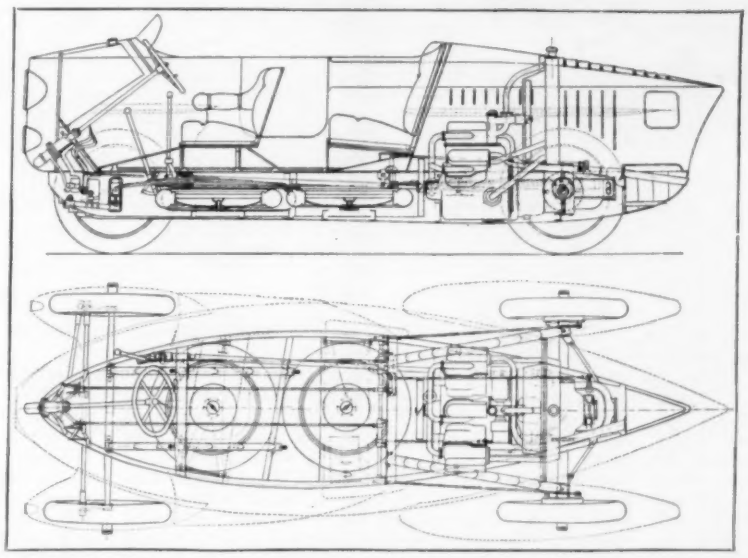
Mechanically this new Rumpler automobile is very good indeed. It has no belts, chains or universal joints, yet in spite of all this the rear axle is spring-supported. Its impulse and acceleration at starting and the brake moment in stopping, as well as the "set" of the wheels, are all technically correct. The front wheels do not hit the frame and wear the tires in making sharp turns, and wherever there is rubbing friction, proper lubrication is provided. The front axle is mounted independent of the frame and passes through it without touching it.

The air resistance of both body and chassis is reduced to a minimum by streamlining to the shape of a drop of water falling. This drop form is strongly maintained both with open as well as with closed cars. The roof of the limousine has the form of an airplane wing, or aerofoil, in profile whereby air resistance at high speed is reduced. A comparison of the Rumpler with the old style cars as to cross-section shows the former to have but a fraction of the air resistance of the latter. The outside is completely smooth; the mud-guards are rudimentary airplane wings; the lamps and spare rim brackets do not project, but are built into the body itself. The spare wheels are neither on the side nor behind the car body, but are concealed in the chassis. The front springs as well as the rear ones are fully built in with the exception of the rear ends of the latter. Merely the ends of the axles project beyond the chassis frame and make air resistance. The exhaust is ingeniously concealed at the extreme rear end of the car. The clutch pedal and brake lever are inside the body, while the running-boards can be folded up when the car is under way.

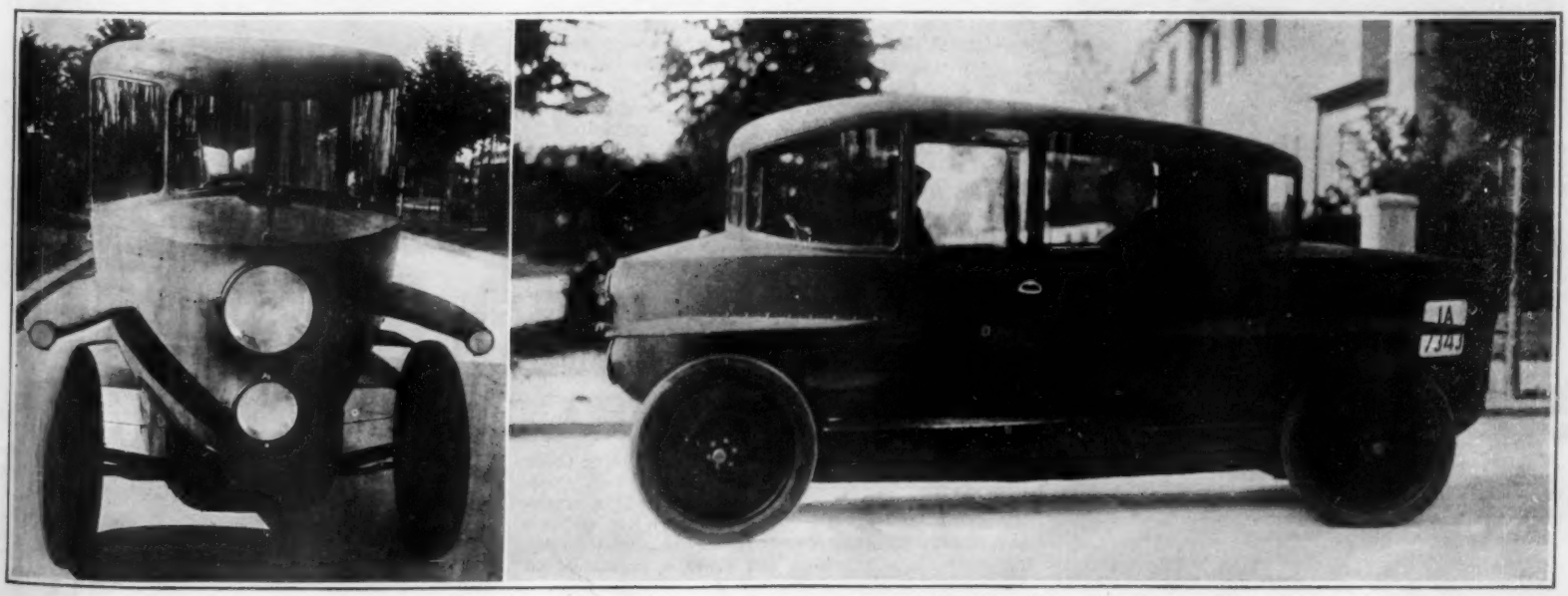
Due to its careful streamlining the air penetration is unsurpassed and the dust question has been solved completely both for open and closed cars. Passengers riding in the latter will have plenty of fresh air and will no longer be annoyed by gas fumes, heat, and noise, for the air stream is drawn back by the radiator fan of the rearwardly-located motor. The oil consumption is reduced to a minimum, and special provision is made to assure no leakage.



Chassis with unit power-plant and swinging rear-axle



Sectional view and plan of Germany's latest automobile production



Left: Front view showing the superimposed headlights and the sidelights mounted on the ends of flat mud-guards. *Right:* Side view; note the horizontal mud-guards

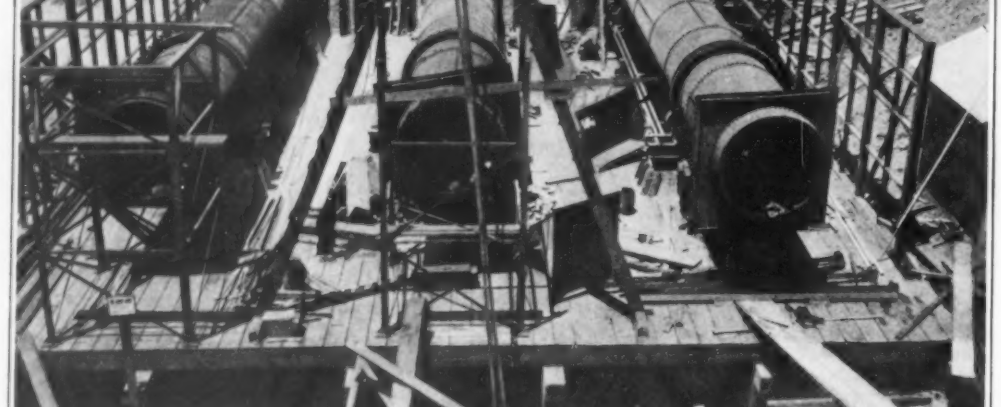
Two aspects of the all-streamline limousine

Potash, An Essential for Plant Growth

The Wide Scattering and Low Concentration of America's Deposits, and What We Can Do About It

By George H. Dacy

THE greatest phosphate deposits in the world occur in the United States and are made much of whereas our potash holdings, which are more than twenty times as large, are little used because they are spread over such an extensive area and because the deposits are of low concentration, none of them averaging much over 10 per cent. Most of the combinations in which potash occurs in the natural state are neither soluble in water nor in acid—circumstances which render their profitable salvage for commercial uses almost impossible. The chief source of all potash salts is a class of igneous rocks known as the feldspar group. Weathering and exposure leach the potash from these safety deposit vaults and lay it down in the soil, in the ocean or in inland depressions. Subsequently, when the water into which this potash has been carried evaporates, soluble deposits are formed. The potash liberated from disintegrated rock is taken up and stored in plants and may be recovered by burning the plant. Hence there are three natural sources of potash: rocks, salty lakes or soluble deposits and plant materials.



Dryers in a California plant where potash is extracted from kelp

Every plant needs potash if it is to make healthy and vigorous growth and profitable crop yields are possible only where the green, growing plants have access to plenty of this food. Potash starvation is evidenced when the leaves of the plant become brown and unhealthy looking and the stems become weak and brittle. Plenty of potash enables a plant better to resist the attacks of fungous diseases, it produces fleshy fruits of fine flavor and texture and it provides sustenance essential to normal growth and development. A problem which has long been of particular concern to the national Department of Agriculture has been the matter of making the most of our natural potash supplies. The government experts have investigated and experimented with this and that method of reclamation and salvage and have built the foundation for what potentially promises to develop into a national industry which to a certain extent, if properly handled, may be able to compete with the imported potash from France and Germany.

Potash salts obtained from the brine of Searles Lake, Cal.

Attempts have been made to use the mineral rocks rich in potash directly as fertilizers, but the results have not been favorable, the expenses of application being out of ratio with the benefits obtained from such practices. The practical plan perfected has featured the treatment of the material with acids or in other ways to render the potash soluble before using it for fertilizing purposes. The fact that most of the minerals and rocks are very low in potash content has complicated this problem as, although successful methods of extracting and rendering soluble the potash were devised, the value of the fertilizer freed did not justify the expenses of these operations. Up to this time, unfortunately, no mine-run rock has been discovered in the United States which contains as high a percentage of potash as the deposits of Germany and France in which the potash is already soluble. The most satisfactory results have obtained from recovering potash as a by-product from some of the industries where potash-rich rocks are used as raw materials.

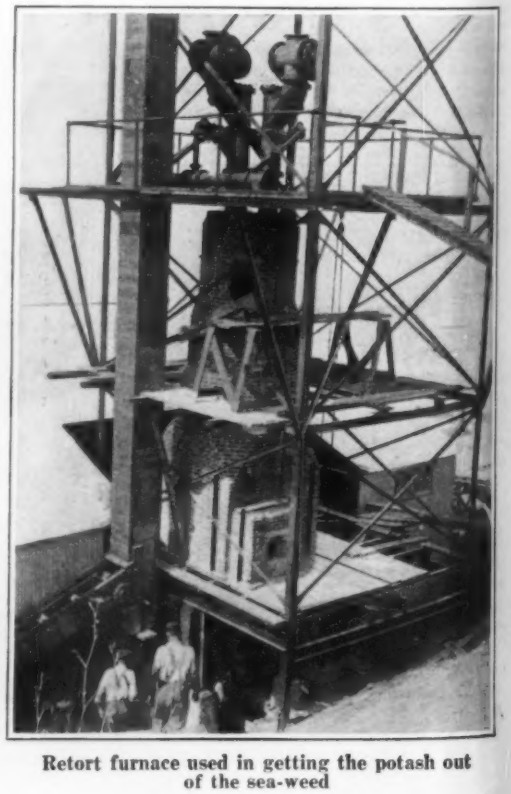
The Federal Bureau of Soils reports, "A study was made of potash recovery from rocks which showed that the most practical results occurred where silicate rock was ignited with lime as in the manufacture of cement, or by the digestion of the rock with lime and water under pressure. In the first process potash is volatilized and passes from the kilns in the process of burning, being collected on electrical precipitators, while in the second it passes into solution during the digestion. In both cases the residue is suited for the manufacture of cement or other building material. At the present time both of these methods evolved by the government soil chemists are being developed on a commercial scale."

"The process of digesting the potash silicates with lime and steam under pressure has occupied our attention and research activities for some time," said Mr. W. H. Ross of the Bureau of Soils when the writer interviewed him recently, "and it has been found possible with pressure such as can readily be maintained in the industries to accomplish a very high percentage extraction of potash. This process is now being developed on an elaborate scale for the treatment of greensands—certain soils occurring along the Atlantic Coast from Delaware and New Jersey on south to the Carolinas, which are rich in potash—with the object of producing bricks and other building material in addition to potash. As a market is found for such building materials, this doubtless will prove a profitable but limited source of potash."

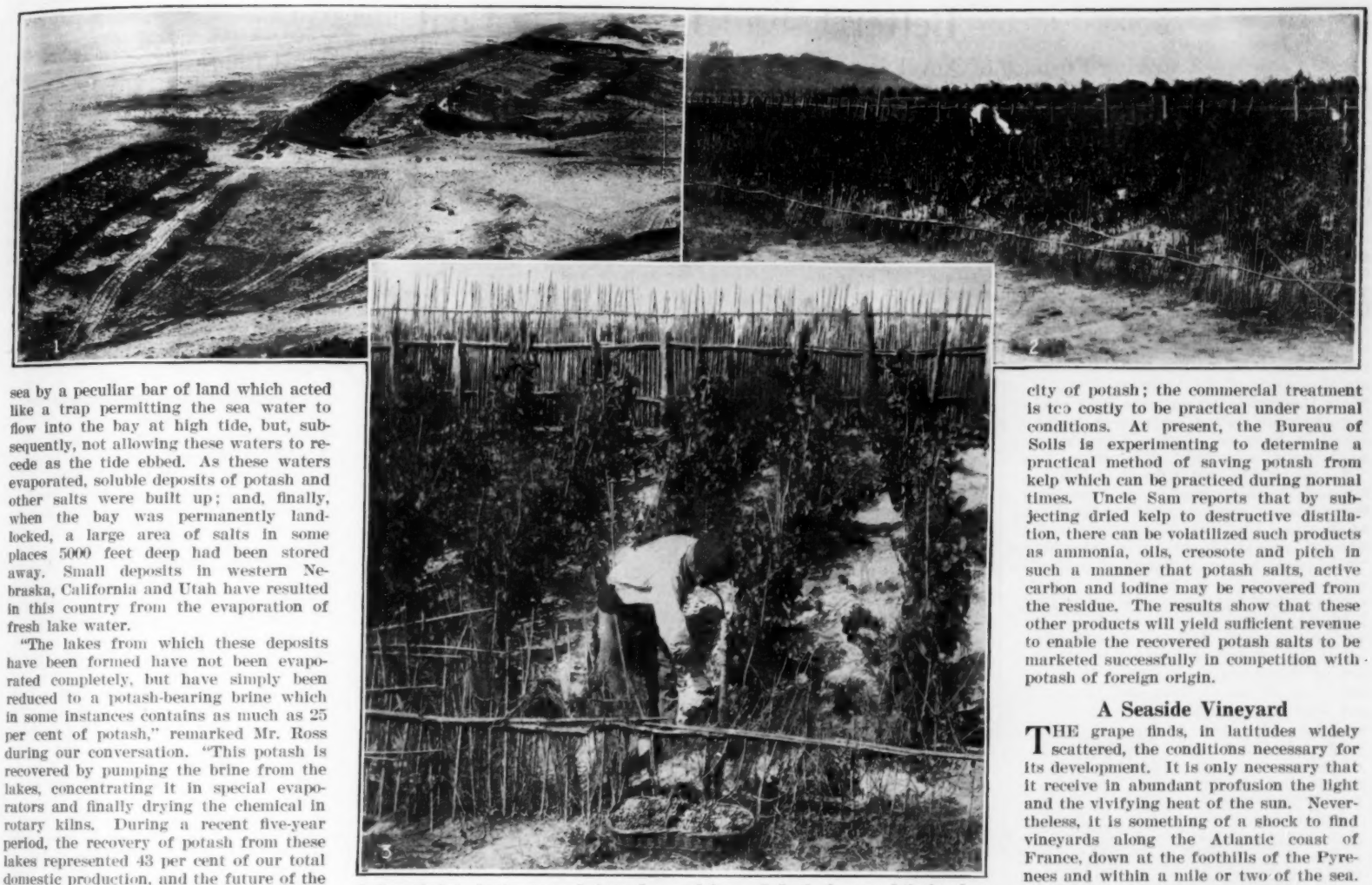
The domestic cement plants in this country produce approximately 86,000,000 barrels of cement annually, with an average loss of about 87,000 tons of potash which was carried away in the fumes previous to the inception of an efficient method of conserving these waste gases. The largest amount of potash recovered in this way since the perfection of this salvage system has been 1621 tons, which that year was 5 per cent of the total supply produced in this country. The trouble has been that the potash volatilized from some plants was too small in amount to save, while in other instances so much dust was collected with the potash that it did not pay to leach the material nor to ship it for direct use as a fertilizer. It is anticipated that shortly either a mechanical method of separating the potash and dust during collection will be devised or a system of reducing the amount of dust which can escape from the cement plants will be perfected.

Potash can also be recovered from blast furnaces as it is volatilized as an impurity from ore, coke and limestone used in the charges. The Bureau of Soils is now investigating such sources of potash recovery and has already ascertained that the percentage of potash in the dust that escapes from some blast furnaces is much higher than that contained in the richest cement dust. However, the practice at most blast furnaces is to purify the gases by the use of a wet purification system which causes the potash fumes to be lost so far as commercial recovery is concerned. The federal authorities are now striving to perfect a dry purification method which will permit of the saving of this potash as they have demonstrated that such a system would feature the conservation of potash at a low cost.

The world's largest potash deposits in Germany and Alsace were formed by the shutting off of an arm of the



Retort furnace used in getting the potash out of the sea-weed



1. General view, showing terraced vineyard on sand dunes. 2. In the foreground the low fence on the earth side; above, the higher one toward the sea. 3. A close-up of the vines

The vineyard by the sea

sea by a peculiar bar of land which acted like a trap permitting the sea water to flow into the bay at high tide, but, subsequently, not allowing these waters to recede as the tide ebbed. As these waters evaporated, soluble deposits of potash and other salts were built up; and, finally, when the bay was permanently landlocked, a large area of salts in some places 5000 feet deep had been stored away. Small deposits in western Nebraska, California and Utah have resulted in this country from the evaporation of fresh lake water.

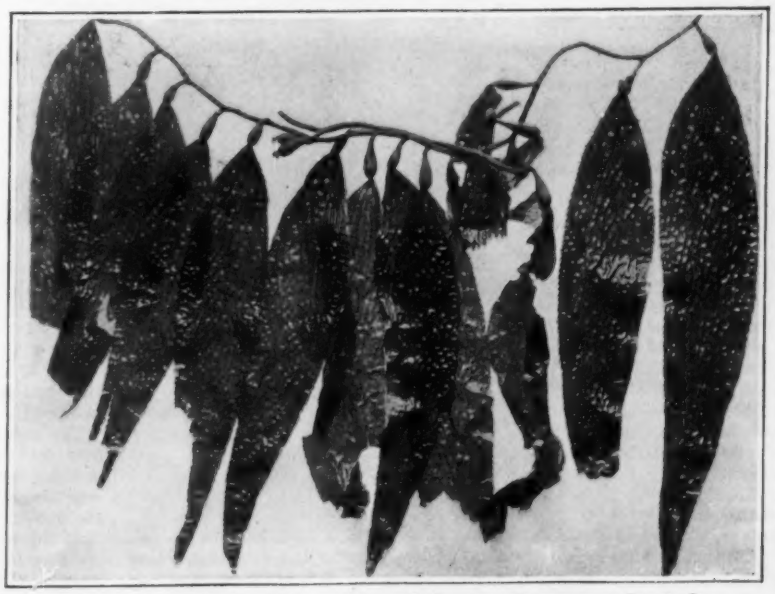
"The lakes from which these deposits have been formed have not been evaporated completely, but have simply been reduced to a potash-bearing brine which in some instances contains as much as 25 per cent of potash," remarked Mr. Ross during our conversation. "This potash is recovered by pumping the brine from the lakes, concentrating it in special evaporators and finally drying the chemical in rotary kilns. During a recent five-year period, the recovery of potash from these lakes represented 43 per cent of our total domestic production, and the future of the industry will depend principally on government experiments now under way to improve these methods of extraction. It is hoped that solar radiation may be harnessed for concentrating the brine; this would markedly reduce the expenses. This is possible as the concentration of the brine as it occurs in the lakes is greatest during the dry season."

"The deposit at Searles Lake, California," continued Mr. Ross, "is the largest natural storage of soluble potash salts in the United States. The salts in the brine of this lake contain considerable amounts of soluble borax which is injurious to crops. Hence it is necessary to eliminate this material from the potash by the crystallization of the recovered salt. This method has been perfected to the extent that the potash as prepared for use in fertilizers contains less than 0.5 per cent of borax, an amount which is not injurious to plant growth."

Sugar beets, wood, wool, kelp and tobacco are all rich in potash, but none of these materials except kelp is treated primarily for the recovery of potash, although their wastes are utilized in this manner. Frequently, these wastes are distributed over such a large territory that it is impractical to attempt to recover the potash. For example, the total amount of potash in the ash of wood burned as waste and that used for fuel amounts to more than 140,000 tons annually — which is about 56 per cent of the amount of potash which we customarily import during normal times. The great majority of this potash emanating from wood ashes is lost so far as economic use for fertilizer purposes is concerned.

A heavy expense is involved in evaporating the large volume of water from kelp and sugar residues. The total potash in the average annual sugar-beet crop amounts to approximately 20,000 tons. During manufacture, this potash remains in solution and a certain part of it is found in the final molasses, a goodly portion of which is fed to live stock and ultimately recovered for fertilizer in the resultant manure. A second portion is used in alcohol production, the still residues being concentrated and used as potash fertilizers. The remaining portion, about one-half of the total, is subjected to a special precipitation process which abstracts the residue sugar remaining in the molasses. Potash occurs in the waste water from this process and is recovered by evaporation. However, unless these waste waters are found to yield other valuable products besides potash, it is doubtful if ever much more than 4000 tons of potash a year will be salvaged in this manner.

The extraction of potash from kelp was rendered practical during the war only as a result of the scarcity of potash; the commercial treatment is too costly to be practical under normal conditions. At present, the Bureau of Soils is experimenting to determine a practical method of saving potash from kelp which can be practiced during normal times. Uncle Sam reports that by subjecting dried kelp to destructive distillation, there can be volatilized such products as ammonia, oils, creosote and pitch in such a manner that potash salts, active carbon and iodine may be recovered from the residue. The results show that these other products will yield sufficient revenue to enable the recovered potash salts to be marketed successfully in competition with potash of foreign origin.



Giant kelp of the Pacific coast, one of the organic sources of potash

A Seaside Vineyard

THE grape finds, in latitudes widely scattered, the conditions necessary for its development. It is only necessary that it receive in abundant profusion the light and the vivifying heat of the sun. Nevertheless, it is something of a shock to find vineyards along the Atlantic coast of France, down at the foothills of the Pyrenees and within a mile or two of the sea. Vineyards, to be sure, are found at various points along the dunes of the Mediterranean shore, but their situation is ordinarily such as to protect them against too abundant rains and heavy winds.

At the Anglet vineyards illustrated herewith, the young vines are protected merely by palisades of tamarisk branches which surround them on all sides. Stakes driven into the sand from point to point keep these barricades firm, while rows of poles, disposed horizontally, contribute still further to stability in the face of the north wind which is in this region the prevalent one of winter.

The sight of a prosperous vineyard so close to the ocean goes to prove that the vine, just so it has sufficient heat from the sun to bring it to normal ripeness, will accommodate itself to pretty much any sort of soil. But who would have supposed that on the shores of the Bay of Biscay, where the waves beat up with such terrific force, one would ever see a plantation of vigorous grape vines?

Yet the proprietor of this establishment does not give to his vines any more extraordinary care than his contemporaries in more usual situations. He prunes them, he supplies them with props, he keeps them well hoed and weeded; and this half-century they have been bearing, each year, an abundant crop of black and white grapes.

Finally, even more curious, this original Pyrenecan vineyard furnishes in addition most excellent table raisins; for after intelligent and patient observations, its proprietor has found how to bring about the variations appropriate to the particular climatic conditions and to the physical nature of this sandy soil. He has sacrificed quantity for quality, and if the bottles of old Anglet in his cellar are not as numerous as those of other vintages, their contents possess no less a delicate bouquet. Needless to say in view of its long record, he has been able to make a complete commercial success of this extraordinarily situated grape farm.—*By Jacques Boyer.*

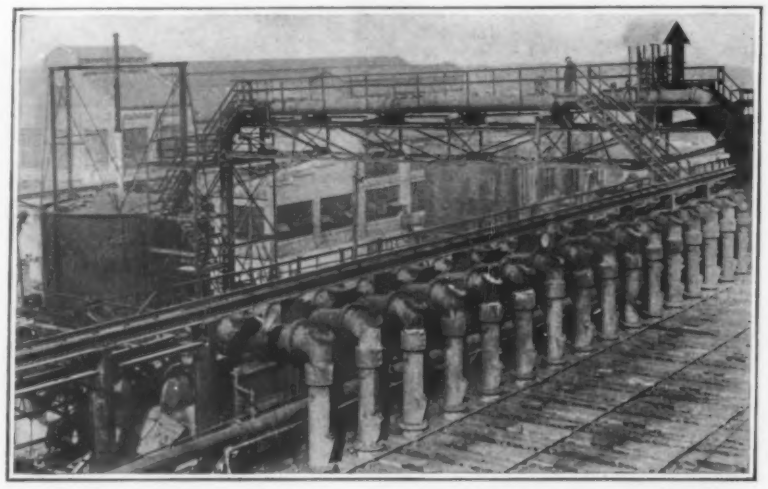
Better Use of Low-Grade Coal

A Coking Furnace of Novel Design Which Greatly Enlarges the Bounds of the Steel Industry

By George H. Dacy

AMONG recent inventions is that of Arthur Roberts, an Illinois engineer—a new oven which admits of coking non-coking types of coal that heretofore have not been available for such disposition. Hitherto the vast fields of Illinois and Indiana coals have been useful only for steaming purposes and have sold for anywhere from $10 to $25 an acre, as compared with prices of $1500 to $3500 an acre for special-purpose coking coals. The inception and perfection of the new coke oven vastly increases our coking-coal resources. Heretofore, only three per cent of our coal supply has been adapted for coking. These valuable deposits have been centralized in the congested sections of the Virginias, Pennsylvania, Kentucky and Alabama, and steel manufacturing industries have been promoted in those neighborhoods proximate to the supply sources of coking coals.

At one middle western coke plant, a total of 80 of the new coke ovens has been installed, consisting of two batteries of 40 ovens each, which discharge their finished product at alternate intervals. These ovens handle 1200 tons of coal at a charging and in a period of 14 hours convert it into high-grade coke and its by-products. The novel coke oven is of the narrow type and flueless. It has been tested out officially and approved by the United States Bureau of Standards. As a result of its use, Illinois coal yields 72 per cent by weight of a satisfactory smelting coke, and produces such by-products as 3.5 to 4 gallons of light oils, 10 gallons of tar, 30 pounds of ammonia sulfate and an average of 11,000 cubic feet of gas per ton of coal.



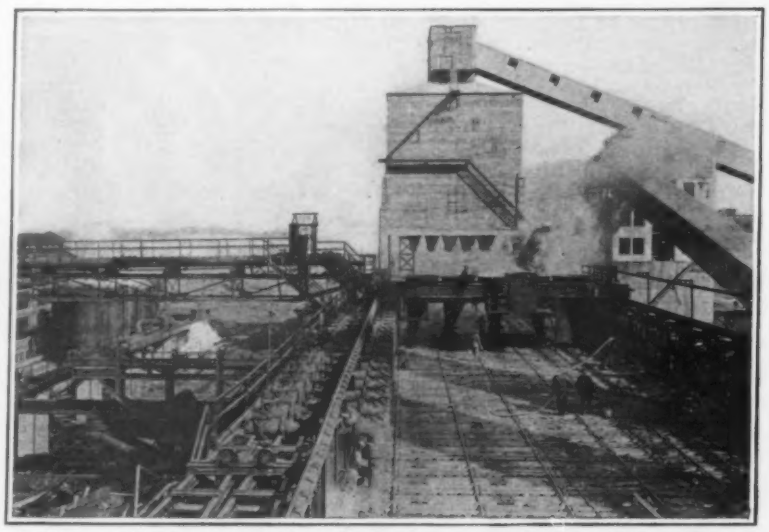
Sectional view of top of the battery of ovens, showing extension mains from ovens to hydraulic mains, crossover pipe which carries gas to the by-product apparatus, and elevated rail on the buckstays on which the car runs

Illinois coal is now yielding a quality of metallurgical coke which is producing the highest grades of iron used in the industries on fewer pounds of coke per ton of metal than has been possible in the past, even where the very best grades of coking coal were employed. The new coke ovens facilitate the salvaging of all the valuable by-products even more efficiently than by the methods and appliances used in European countries where the long coking period is universally practiced. In Europe the greatest efficiency is not realized from the coking oven, because according to overseas methods it takes from 30 to 36 hours to coke an oven of coal, whereas in this country the processes are expedited as much as possible, the usual coking period ranging from 17.5 to 19 hours.

The American system of rapid coking has featured the operation of the coke ovens at very high temperatures, with the result that the ovens deteriorate rapidly while many of the hydrocarbons are cracked so that inferior by-products are produced. The new coke oven recently invented corrects all these previous defects, being operated at a low temperature which permits of saving uninjured the hydrocarbons and by-products. This oven not only makes a fine grade of coke from the non-coking varieties of coal, but it also produces a finer quality of coke from the specialized coking coals than ever previously has been obtained. These ovens are more durable and efficient, while their operating expenses are much lower than those of the old style. The new types of coke ovens are the largest and strongest that were ever built, while they feature the outstanding advantage that every operation center is of easy access and not remotely situated away down in the hot temperature zones as is the case in many of the old-fashioned ovens now in use.

This modern oven is a scientific machine built to create economically and efficiently in a flexible way the conditions required for the coking of coal. It is extremely flexible in producing and applying the agency required to coke the coal, and permits of changing the conditions to comply with the requirements of every type or variety of coal. It cokes a larger quantity of coal per oven per given unit of time than any other oven ever built, and it performs this work at a much lower temperature than is possible in any other coke ovens. It produces a better quality of by-products than other ovens because it utilizes only the required heat of distillation in proper volume, and does not have to depend on abnormally high heats essential in other ovens in order that a sufficient capacity of coal per oven per day may be developed.

Unlike other coke ovens, the Roberts oven is so elastic that it will handle any kind of coal without costly alterations. The tendency of all coke producers was to utilize the wider types of ovens, until Mr. Roberts began his early experiments which have been extended over a period of 12 years and which have been responsible for the production and perfection of the new Roberts oven. His researches demonstrated conclusively that the narrow types of coke ovens are more efficient and now ovens of this variety are universally popular. All other ovens employ the skin-friction process of heat utilization while the Roberts' oven emphasizes the utility of the impingement-of-heat process.



Battery of 40 of new type by-product coke ovens. The car, which carries 15 tons of coal, is shown suspended on the rails over the top of the ovens

Each individual part of this new type of oven is designed to perform in the most economical and efficient manner its special function without saddling any extra burdens on the other parts. This feature has been more or less neglected in other coke ovens.

The invention of a coke oven which will coke non-coking varieties of coal vastly extends the operations of the American steel industry, which previously has been restricted in development to those sections close to the supply sources of coking coal. It permits of the potential development of steel production on a large scale in cities of the Corn Belt states. The Mississippi River provides cheap water transportation for the transfer of the ore from the northern ranges to cities located along that mighty stream. Non-coking coals can now be used to produce coke for converting this ore into steel. Take, for example, the case of St. Louis. The middle western and southwestern steel markets served advantageously from St. Louis as a center consume more than 10,000,000 tons of steel annually. The use of the new coke ovens will promote the potential production of a majority of this steel close to the localities where it will be used.

Germination of Light-Sensitive Seeds

THE *Botanical Gazette* for April contains an important article by Wright A. Gardner on the effect of light on germination of light-sensitive seeds. In his investigations Mr. Gardner attempts to discover the fundamental relation of light to the germination of seeds, and to show just what light does to start germination. The seeds of about 15 different species and varieties were used. The author presents his results in tabular form and concludes:

The seeds of *Rumex crispus*, *Datura Stramonium*, and *Phoradendron flavescens* were found to be light sensitive. The germination of seeds of *Rumex crispus* and *Phoradendron flavescens* was promoted by light; the germination of seeds of *Datura Stramonium* was hindered by light.

Abrasion and removal of coats (overy walls) of *Rumex crispus* seeds promoted their germination in darkness.

Treatment of seeds of *Rumex crispus* and *Oenothera biennis* with concentrated sulfuric acid caused an increase in the percentage of germination in darkness.

No reciprocal relation between the effects of light and temperature was found. Light was not necessary for the absorption of sufficient water for germination. Injection of water did not yield increased germination in darkness. Almost all kinds of single electrolytes, regardless of the nature of the ions, seemed to promote germination of seeds of *Oenothera biennis*, *Nicotiana Tabacum*, and *Verbascum Thapsus* in darkness. Embryos of seeds incubated in light became more acid than those incubated in darkness. Light seemed to activate lipolytic enzymes which hydrolyzed fats to fatty acids.

The germination of seeds of *Rumex crispus* in darkness was promoted (increased) by hot water treatment, abrasion, treatment with concentrated sulfuric acid, sodium sulphocyanate, and hydrogen peroxide.

The germination of seeds of *Nicotiana Tabacum* in darkness was promoted by soaking in solutions of hydrochloric acid, sodium sulphocyanate, and hydrogen peroxide, as well as by the use of many single electrolytes as substrata.

The germination of seeds of *Verbascum Thapsus* in darkness was promoted by the action of light, fluctuation of temperature during incubation, alternating high and low temperatures, soil, and many single electrolytes as substrata.

The germination of seeds of *Oenothera biennis* in darkness was promoted during certain seasons by hot water treatment, sulfuric acid, preliminary incubation at low temperature, incubation in alternating high and low temperatures, and single electrolytes as substrata.

The germination of seeds of *Daucus Carota* in darkness was promoted by increased oxygen pressure and preliminary incubation at low temperature, while it was hindered by soaking in hydrochloric acid and by the use of single electrolytes as substrata.

It appears that, while these experiments are not complete enough, as regards either species or conditions, for final conclusions, it would be safe to say that the treatments used, in general, promote germination.

Taking the Fire Hazard Out of the Oil Tank

THE immense losses due to fire caused by the contents of large oil or gasoline tanks igniting, have been made impossible by the construction of a new type of oil tank, or rather an oil-tank cover, which absolutely protects the contents of a big container from conflagration, even though fire be built on its very top. Heretofore efforts to protect stored oil and gasoline have been confined chiefly to making the stationary roofs of the tanks air tight and closely joined to the vertical walls. The new principle used in this recently devised protector is that of a floating roof which rides upon the surface of the oil regardless of its level and so at all times prevents its exposure to the air. In this way the roof is of value in preventing evaporation, as well as in preventing fires.

In order that the roof may ride easily on the oil and rise and fall with the changing level, the diameter of a given roof is several inches less than the diameter of the tank. For a 50-foot tank the roof diameter would be 48 feet. The remaining space between edge of the roof and tank wall is filled by ingenious gravel-filled buffers, which provide a sort of cushion that easily rides over any irregularities in the tank wall. These gravel carriers are built of 10 or 12 gage metal and are each hinged to the roof and held in place by means of a spring.

For the purpose of demonstrating the absolute protection afforded by this invention the makers have frequently piled brush on the top of one of these roofs and then after saturating it with oil have set it afire.

On the roof of the new oil tank, which rises and falls like a gas tank

Despite the intense heat of such a test, the oil below has never caught fire, even the edges being thoroughly shut off from air by the gravel-filled buffers.

New Kind of Pipe Made of Fiber

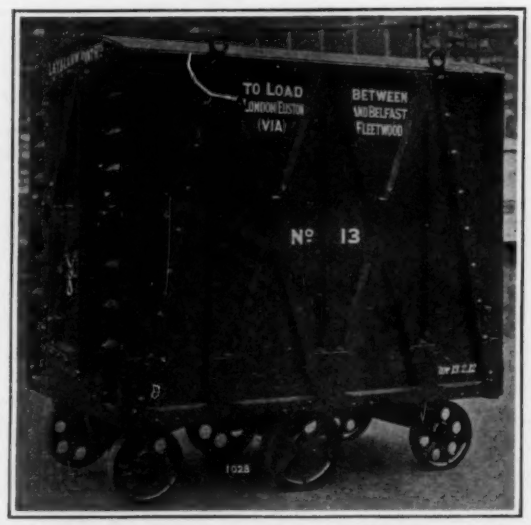
A NEW kind of pipe has been put on the market which, it is believed, will solve many troubles now encountered in steel and other straight-line pipe. It is claimed that sulfuric, hydrochloric, acetic and other acids do not injure it and that chlorine gas will not harm it.

Its strength, unlike that of wood pipe, is not dependent on iron bands, but is inherent in the pipe itself, says an authority. A little paint scratched off wood-stave pipe and the bands will corrode, leaving it no longer watertight. The joints of this pipe are, moreover, screwed and therefore reliable.

As for weight, however, it is one-quarter that of iron or steel pipe; as for strength it has stood 4124 pounds per square inch of cross-sectional area applied externally, and 782 pounds applied internally. It is recommended by the manufacturers for use under a pressure not exceeding 600 pounds per square inch, as they assert that it is capable of withstanding much greater pressures under actual working conditions.

The Massachusetts Institute of Technology has shown that it expands only twenty-six ten-millionths of an inch per degree Fahrenheit. Sudden changes of temperature do not affect it, but it is not recommended for use in conveying steam or hot water at over 180 deg. F. Being light, 25,000 ft. or more of 3-in. pipe can be carried in a single carload. Two-inch pipe weighs 1½ lbs. per ft.; 2½-in. pipe, 2 lbs.; 3-in. pipe, 2.5 lbs.; 4-in. pipe, 4.5 lbs., and 6-in., 7 lbs. The threads are well formed and can be made with hand-threading machines furnished by the manufacturer. Even 6-in. pipe can be threaded by hand.

It is at present made in only 7-ft. lengths or shorter, and it can not be provided with fittings of like material. Lead-lined iron ells and tees are furnished to go with the pipe, also combination couplings for connecting it with iron pipe and pumps. The fiber pipe can be leaded into cast-iron fittings. The cost is unexpectedly low, and it can be installed for half as much as metal pipe, because it is light and easy to handle. A coating of a specially-prepared paint makes the joints airtight. No tools are needed to lay it.



The single container, showing the wheels on which it is mounted

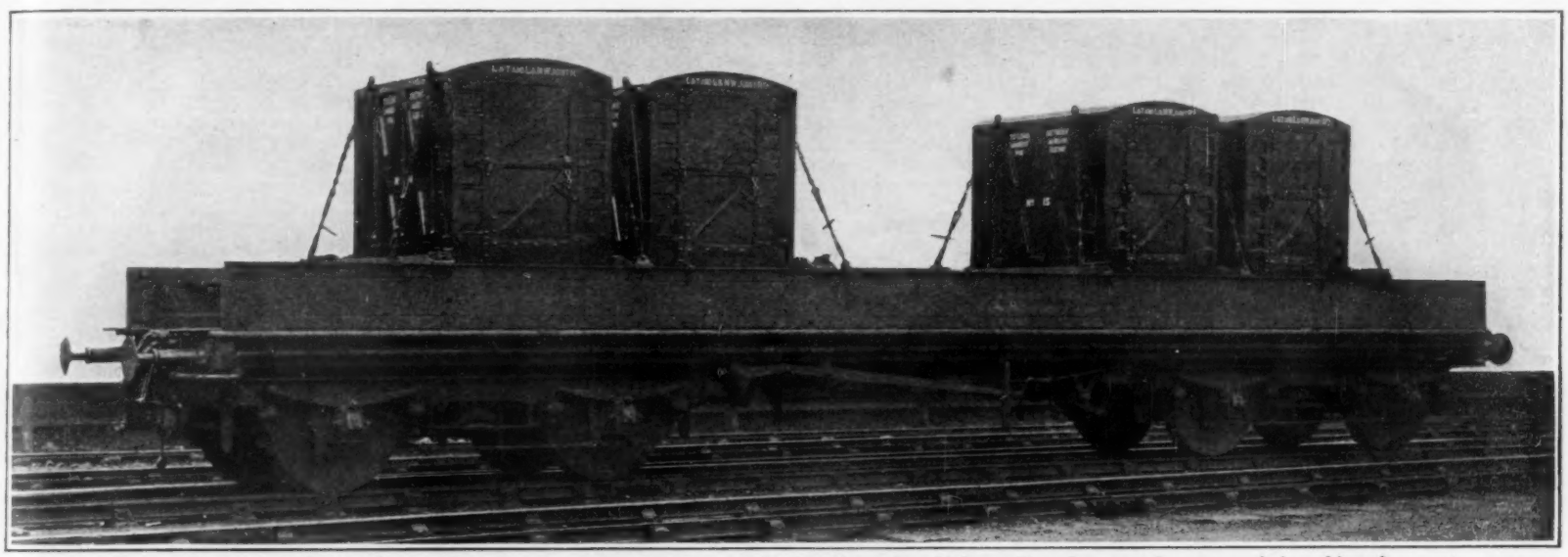
Container System in Operation on British Railways

WE recently illustrated a system of container cars which is in operation on the lines of the New York Central Railroad, and the accompanying photographs, for which we are indebted to the courtesy of the *Railway Review*, show the containers used for freight and mail service between London and Belfast, by way of the London and Northwestern Railways. The containers have been built with the following dimensions: length outside, 6 feet 11 inches; width outside, 4 feet 8 inches; height, including wheels, 7 feet 1½ inches; and the capacity of each container is 154 cubic feet. They were designed for the rapid transit shipment of parcels and baggage between train and boat at the Fleetwood docks, from which the Belfast steamers sail, and between the boat and quay at Belfast. They are carried on 45-foot flat cars, accommodating four containers each. The framing of the containers is on the outside, and they are finished with flush walls and varnished on the inside, so that there are no projections to damage the contents. At each end of the containers is a door through which, when on the truck, they can be loaded or unloaded from either side of the train.

Two steel lifting-slings are fixed around the bottom and sides of each container, and terminate at the top in eyes for the chain hooks of the lifting cranes. Each container is carried on six broad-faced wheels, the center pair being slightly larger than the two outer pairs, so as to make it easy to handle the containers on the quay side.

Each container is secured on the car by four chains which are hooked to the eyes of the lifting slings and lead down to the sides of the car, the slack being taken up by screw shackles. Steel channel-bars adjusted across the top of the car sides assist in keeping the containers in place.

According to our contemporary, the containers have proved very satisfactory. Delay in transit is obviated, and since the freight travels under seal from the sender to the receiver, the risk of theft is eliminated. Their use does away with four distinct handlings, and this, of course, reduces the liability to damage, the goods being carefully and closely packed. This result is shown by the marked reduction in complaints and claims which has been noted since the containers were put in service.



Flat car on the London and Northwestern, carrying four of the containers in which small package goods are now being shipped

Iron Corrosion by Carbon Dioxide

AN instance in which the corrosion of iron pipes was directly traceable to the presence of carbon dioxide in steam is reported by a writer in a German chemical paper. The wrought-iron pipes carrying away the condensed water from the steam radiators employed to heat the air in a large drying plant were found to suffer greatly from internal corrosion, so that they had to be renewed about every six weeks. Investigation led to the conclusion that the cause must be sought in the steam, or, rather, in agents accompanying the steam, the most probable being carbon dioxide in considerable amount. On pursuing the matter further it was found that the water-softening plant for the boilers was not up to its work, and allowed a large proportion of calcium carbonate to pass into the boilers, where it decomposed, the whole of the liberated carbon dioxide accompanying the steam through the heating system.

Building Better Homes

Factory-Made Houses that Nevertheless Mark a Return to the Ways of Our Grandfathers

By A. H. Scott

THROUGHOUT New England there are standing today many farmhouses and town residences of from seventy-five to two hundred years old which are still as habitable as when originally built. These old houses were built when materials and labor were comparatively cheap and the lumber and hardware employed in their construction were first class and the work done painstaking and fine. In former days of hand work artisans took great pride in fitting even the minute and unseen parts so carefully that no structural weakness would develop to mar their work as time went on and the building was subjected to rigorous climatic changes. On the other hand, we have today the average house put up by the speculative builder which in a decade or two will be a shabby-looking structure inside and out, particularly if it is a two or three decker which has been rented and not lived in by the owner. If these buildings had been fabricated with care and the same style of framing employed as that used by our ancestors they would not show nearly such rapid deterioration even under the modern rental system.

Frames in position in the order of their erection

At present the nation-wide slogan is "Own your own home," and it is a hopeful sign that the drift does seem to be in this direction, as the majority of building permits being issued just now are for the erection of small single houses to be used as homes by men of average means. Such houses are usually built under individual contracts and the progress made watched over day by day by the prospective home owner, who, having prospects of spending a considerable part of his life under its roof, sees to it, as far as he knows, that no slipshod work or faulty material enters into its construction.

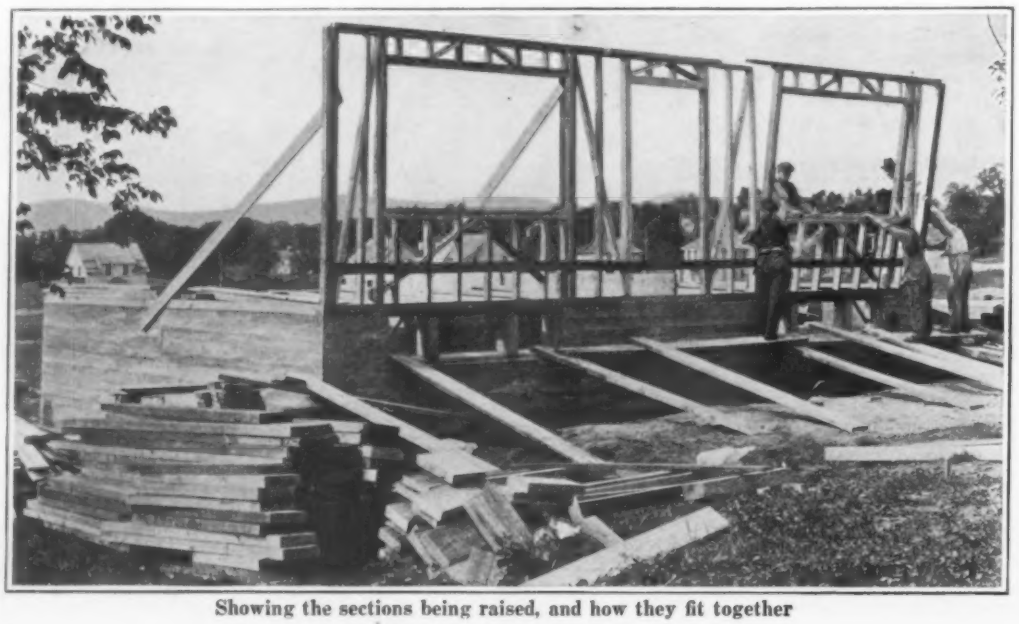
In our forefathers' time when a home was to be built the foundation was made ready and the frame assembled flat upon the ground, and when all was ready the homesteaders in the vicinity gathered for the house-raising. The work of raising the framed sections into position and pinning them together was quickly accomplished, and not infrequently the building was completely sheathed in and roofed over by sundown. This framing of the building on the ground in advance necessitated diagonal bracing of the members in order to hold them together while being raised. This diagonal bracing is also the secret of the strength and lasting structural qualities of so many of these fine old homesteads, and unless they have been neglected or uninhabited and thus fallen into actual decay few of these old houses will be found out of plumb or to have developed other structural faults.

The modern method of preparing the wall-supporting structure is termed "balloon framing," the studding being set in a vertical position with no diagonal bracing of any kind, the wall depending for its rigidity merely on the sheathing which is nailed to the outside and to a slight extent upon the lath. This method of framing has led the present generation to become accustomed to seeing unsightly cracks appear in the plaster, floors drawn away from the baseboards and doors that appear to have been made too large for their casings. Such faults are usually ascribed to the inevitable shrinkage of the timber, causing the lath to pull from the studding and crack the plaster, etc., which is true enough; but it is equally true that a house can be so framed that such flaws can be to a large extent prevented. And substantial and lasting quality at a reasonable price is what is being insisted upon by the man building a home today. How to combine this accomplishment with the ready-cut feature which is necessary if a one-family house is to be maintained within the limits of the average man's credit is a problem which is being solved by adapting the old-time rugged brace-framing methods of our forefathers to meet modern requirements. The term "readiframed" has been coined to describe this method of preparing the frame, and it is truly all the name implies. By referring to the cuts it will be observed that the frame is actually made in conveniently-handled sections ready for quick assembly in the building. The diagonal bracing is seen to be continuous, holding each stud firmly in place and perfectly rigid, insuring a wall that will not allow the plaster or stucco to crack, and a house that will not sag.

These houses are built on a uniform plan of internal arrangement, but the exterior, such as piazza, doorway and finish, can be so modified that their similarity in this respect is unnoticeable. This allows for all the framing and all other so-called "rough parts" to be cut to fit at the mill, while the fabrication and assembly of the frame proper is a distinct advance over the method of merely numbering the individual pieces and shipping them separately to the builder, who necessarily spends considerable time sorting them over and nailing them together. The lumber is first dressed on all four sides and then cut according to drawing in sets of five, as this is the minimum number of any design which it has been found economical to fabricate at one time. To prepare the material for five houses requires only seventy working hours at the mill, all the sawing for five duplicate houses being done by one man, who has to make but one reference to the drawings for each set of five of any one part. These parts are piled in sets of five and move forward to the assemblers, who nail the framing material together and number the parts thus formed. The diagonal bracing is all cut from material which would ordinarily go to waste if the lumber were hand-sawed on the premises. To take a specific instance, many piazzas are seven feet wide, an odd width which results in much waste of good material. The piazzas of this line of houses are therefore made eight feet wide, the left-over four feet from standard twelve-foot studding being used to make two two-foot diagonal wall braces. Thus a saving is not only made, but strength is added to the building and a more spacious piazza is secured. The diagonal bracing is also used between studding of partitions, where it serves as a "fire stop," a feature demanded wherever building inspection is in force. The sections when completely assembled are made to fit perfectly, and in addition to being numbered are otherwise so marked that no time will be lost in fitting when the house is being erected. The assembled sections are so designed that they will load well on a flat car, one car usually being sufficient to carry the framing and other material for one house. Such materials as brick, plaster, sand, etc., are not included, as they can usually be more advantageously obtained at the place where the house is to be built.

The accompanying illustrations show various stages in the erection of a house fabricated on this principle, the actual time required for erecting and securing the first-story wall-framing of this particular house being thirty-eight minutes.

In order to raise further the standard of small-house construction a number of precautions not usually considered are observed to insure lasting quality and a satisfied home owner. The first step is to provide a footing for the cellar walls; this is a layer of rich concrete six inches thick and eighteen inches wide upon which the concrete walls are built up. The effect of this is to insure an absolutely firm foundation, which prevents cracking or settling of the cellar walls and consequent sagging of the whole structure. Sills and other semi-exposed parts, such as window frames, are tarred or linseed oil treated to prevent absorption of moisture, which thus eliminates alternate wetting and drying so conducive to timber decay. Special care is taken when putting on sheathing. Ordinarily these boards are nailed on with little care regarding tight joints, and often there are spaces a half inch wide between them. The proper method is to use tongue-and-groove lumber put on diagonally, over which a layer of three-ply



Showing the sections being raised, and how they fit together

waterproof building paper is used. This waterproof paper is always used whether the finish be of clapboards, shingle or stucco, and insures a wall through which no dampness can penetrate. The diagonal method of sheathing adds further to the rigidity of the structure and takes care of any possible shrinkage. Instead of being merely placed in position, the cellar windows are set in concrete and well packed to prevent the entrance of draughts. Often a cellar window frame will carry so much weight that if made of light material it will cause the building to sag. The two-inch ash frames employed in making the cellar windows of these houses, however, are blocked in two places, as will be observed by referring to the cut. All window frames are flashed with zinc, which is, of course, non-rustable, this being an important precaution which effectively keeps out wind and water. Bay windows, which are usually a disappointment because of draughts which enter from below, are protected at this point with a sheet of heavy canvas, first shrunk in salt water, followed by several coats of white lead and linseed oil. In putting on the roof the utmost care is used. The best grade of ⅜-inch by 18-inch cedar shingles are used, being laid 5 inches to the weather, with galvanized non-rustable nails, which makes the roof covering three courses thick.

Finished house built about a mill-made frame

Lining a Creek with Concrete

FORMS designed for quick and easy resetting as well as great adjustability to position on tangents or on curves were used in recent work during the deepening and lining with concrete of a creek channel in Syracuse, New York. The channel was deepened, after being unwatered, by a walking dragline excavator. Progressing downstream from the end of the deepened channel the concrete invert was constructed. All that was required in the way of forms for this invert construction were steel channels set to line and grade at the outside edges of the invert.

Five units made up the traveling form used for constructing the side walls. Mounted on double-flanged wheels, each unit was 14 feet in length. The track on which the form traveled was laid directly on the concrete invert. Three rigid trusses spaced 6-inch centers and cross braced made up the individual units of the forms. Attached to arms sliding with the upper and lower chord members of the trusses were the steel faces of the forms against which the concrete was deposited. The face forms could be moved horizontally to gain adjustments in desired positions. The movement and adjustment of the face forms was controlled by three jack-screws at each end of each truss. This arrangement made it possible to insure absolute rigidity once the face forms were set.

The units were spaced four feet apart on tangent stretches of the creek. The intervening spaces were filled by planks for which grooves were provided at the ends of the face plates. The units, on curves, were set at a minimum distance of 12 inches apart at the top of forms on the inside of curves. Here the planking was cut to fill the existing intervening spaces.

After the forms were set the track was properly alined between the two outer edges of the invert. Upon rolling the forms forward the form faces were jacked out to the back line or the earth face of the concrete side-walls. The space between the form-faces and the excavated bank was filled with earth and compacted by tamping. After this had been completed the base forms were pulled horizontally away from the earth banks by the screw-jacks about 17 inches and the space, 12 inches, to be filled was ready for pouring concrete.

A secondary traveler running on a track on top of the form trusses carried the concreting equipment. Outriggers carried chutes from the hoppers on top of the cars to the side slopes. At this point the chutes emptied into other chutes leading down into the lining space. The concrete coming from a central mixing plant was lifted into the hoppers and chuted down to the spaces to be lined. The hoist on the secondary traveler car joggled the chutes up and down while pouring the concrete, and the chutes were raised also as the concrete rose in the space being filled.

A 90-foot section could be puddled and concreted in a working day by using these forms, it is claimed, and the framework was pulled ahead by its own power for the next day's work.

Left: A close-up view of the form used for the concrete. *Right:* The finished job

Making a creek over with concrete bed and concrete banks

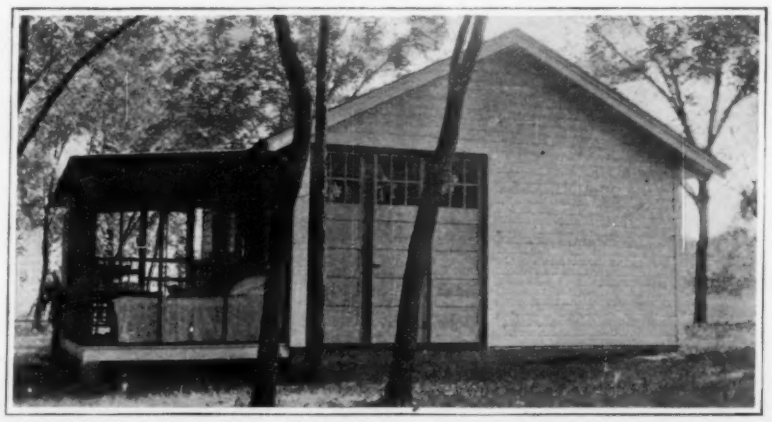
Garage the Dwelling-Place While the House Goes Up

WITH the building-material market playing vigorously on the up-and-down scale and things in general still undecided, several prospective home builders in Lincoln, Nebraska, have adopted a rather unique solution. Rental of apartments maintains its stand at the same high rates, and with this in view the parties in question are erecting buildings on new and relatively low-priced sites in the Peck's Grove addition in the edge of town. These buildings are being furnished in beaver board and plaster to tide the families over the winter. Next spring they will be vacated when the homes have been built, and then used as garages.

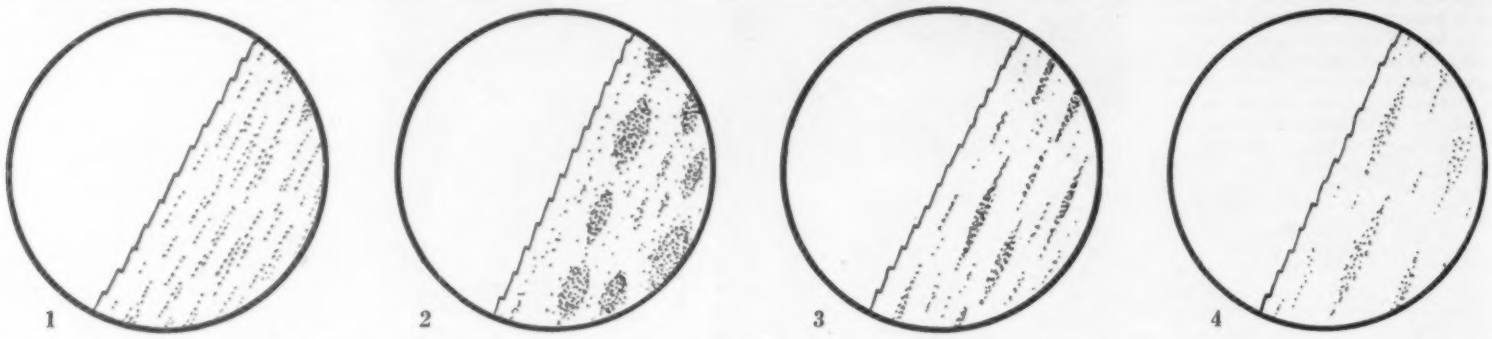
Mr. Fred Yocel, a contractor, claims the idea as his. He put the proposition to one of his clients and the result was that the first building was started. The buildings as a whole are on temporary foundations. With the ultimate position of the residences well planned, the buildings are set in place, though one or two of the tenants intend to move their structure in the spring and add it to the new home. One owner plans to annex the garage to the house and build a sleeping porch overhead.

The idea is growing in favor and several buildings of this type are being constructed at the present time. With plans well laid, the ultimate program of building will go on next year, and in the meantime the owners are enjoying home privileges with hardly any rental, and this adds a substantial sum to the amount to be allotted for the home building later.

A resident of a Jersey suburb of New York has profited by this idea even more than his western contemporaries. He bought his lot in 1916, expecting to build at once. Kiting costs prevented this, so he put up a two-room frame structure and made it comfortable inside. He then beat the game further by practically building the permanent residence himself in spare time—he figured he had all the time there was to complete it in. This summer, after his house was finished he moved out of the two-room quarters and rented these to the owner of the adjoining lot, who is now living in them while he builds his house. Then the owner will convert it to a garage and demolish the shanty he is now using for his car.



Beaver-board-and-plaster structure used as temporary residence during the construction of a permanent one, and then demoted to garage service



1. Chinese (black). 2. South African Bushman (black). 3. English (dark brunette). 4. Early Egyptian of about 4000 B. C. (light brown)

Highly magnified portions of shafts of human hairs of various colors and from individuals of various races, showing variation in the pigment-granule patterns

Human Hair Under the Microscope

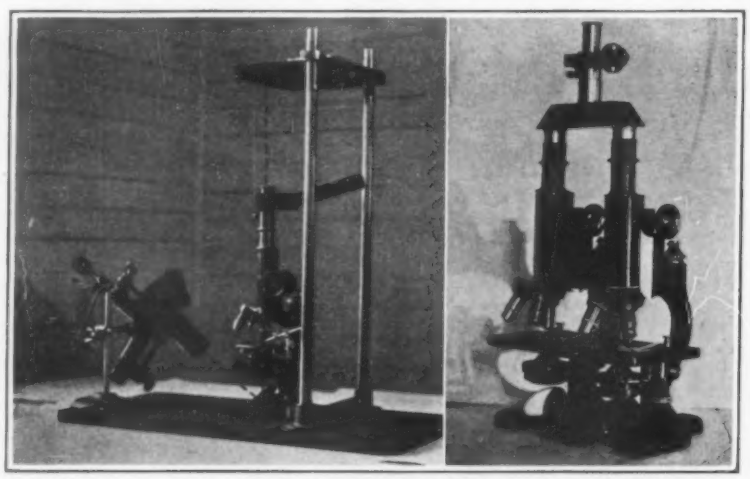
Recent Acquisitions to the Knowledge of Its Minute Structure, and Their Applications

By Leon Augustus Hausman, Ph.D., Cornell University

THE microscopic study of the structural elements in the human hair has, in recent years, begun to be of considerable value to investigators in several diverse departments of scientific research. Physicians and physiologists, detectives, anthropologists, archæologists, and others, are turning increasingly to the aid which the microscope can render in search of answers to some of their many questions. A few fragments of hair are found upon a murdered man's clothing, or in his hand. Are they his own, or some one's else? Of what race was this some one else? Man or woman? Hair dyed, or of natural color? Artificially waved, or naturally curly? Blonde, brunette, or red? Or the archæologist finds a mass of hair splinters in some ancient burial mound. Are they human or animal hairs? And if human, of what race? These are a few of the host of questions which a detailed study of the human hair under the microscope is helping to answer.

Grossly the human hair is a mere homogeneous shaft; minutely it is a complexly constituted structure, with definite elements found in definitely varying relationships. Fig. 13 shows the three structural units of the shaft of a typical hair. Through the center of the shaft runs a core or pith, technically known as the *medulla*, composed of shrunken, massed, distorted cells or chambers, more or less filled with air, and connected by a ramifying series of cornified filaments which usually completely fill the medullary column. Surrounding this structure is the *cortex*, or main shell of the hair shaft, made up of elongate, fusiform cells almost completely coalesced, and forming a nearly homogeneous and hyaline investiture. The outermost integument of the hair is termed the *cuticle*, and is composed of thin plates or scales of irregular outline imbricated like the shingles on a roof or the scales on a fish (Fig. 14). The varying physical make-ups of these three elemental structures of the hair and their varying relationships produce the many different textures which we observe in hair from various individuals.

A fourth element in the hair shaft hitherto of seemingly little worth in connection with analysis of hair samples is the pigment. This is usually distributed among and within the closely compacted cells of the cortex, in the form of granules of definite shape, size, color value, and color depth. Moreover, the patterns formed by these granules within the cortex have been found by the writer to vary in certain definite and predicable relationships in hairs of different color and from peoples of different race. In some hairs pigment is found also among the cells of the medulla, and in the case of reddish hair it is present in the cortex as a general diffuse color and not gathered into masses or granules.



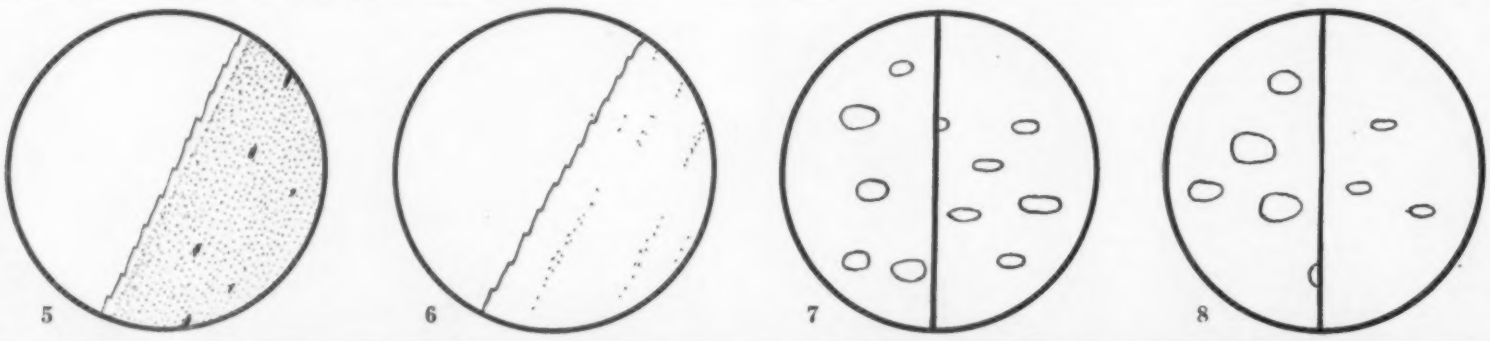
Left: Micro-mensuration apparatus. The greatly magnified image of the object under examination is thrown upon a scale located on the screen above, the course of the light rays being indicated by the dotted line. *Right:* Two microscopes fitted with the comparison ocular, which brings the two objects into the same field for delicate comparisons

Two of Dr. Hausman's microscopic attachments which he uses for the accurate study of minute fragments of human hair

Figs. 1 to 6 illustrate some of the strikingly different characters of the pigment granule patterns to be found in human hair. In order that these may be clearly seen and studied it is first necessary to subject the hair fragment under examination to several processes, the objects of which are: first, to clean the outer surface of the hair from oily substances, and second, to render the shaft as transparent as possible without distorting the elements which compose it. Under the highest powers of the microscope at present practicable the granule patterns can be clearly discerned and even the form and size of the individual granules made out. Two minute fragments of black hair, one from a Chinese, the other from an English brunette, would hardly reveal the secret of their derivation except under such study. The different and characteristic granule patterns of these two hairs are shown in Figs. 1 and 3. The typical granule pattern in the hairs of negroes is shown by the hair of the South African Bushman in Fig. 2. These granule patterns differ in the different races and tribes, but are in general in the shape of ovoid masses of varying sizes. Fig. 5 shows the appearance of so-called red hair. Here the majority of the pigment is diffuse in form, with larger masses of pigment than is usual in most cortices, distributed irregularly.

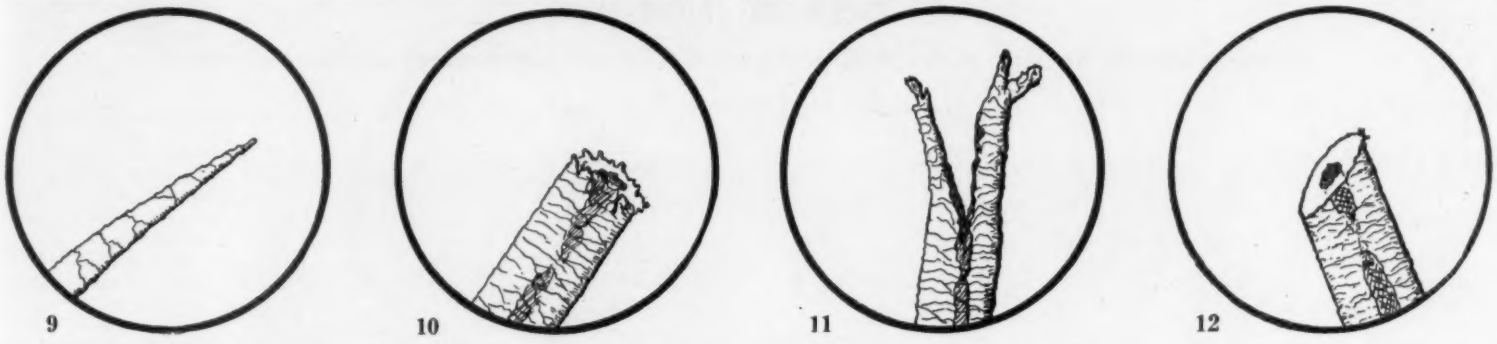
Not only are there marked and characteristic variations in the granule patterns, but also in the physical characters of the granules themselves. The most obvious of these are the variations in form and size of the granules. Figs. 7 and 8 illustrate the nature of these variations, as seen with the device known as the comparison ocular, shown in the photograph.

In making accurate determinations it is frequently necessary to record long series of measurements either of the granule patterns or of the individual granules themselves. For such nice mensuration the apparatus



5. English (golden red, pigment largely diffuse, with some few brown granules). 6. English ("tow-head"). 7. *Left:* American Eskimo; *Right:* Chinese. 8. *Left:* Negro, Bantu stock, Fingu tribe; *Right:* "tow-headed" Englishman

Two more shaft views; and the individual pigment granules from hairs of four diverse individuals, as seen with the comparison ocular



9. Characteristic appearance of the uncut, natural end of a woman's hair. 10. Usual appearance of a man's hair, the end cut with scissors. 11. Hair shaft with broken end. 12. End of hair shaved with razor

How the microscope reveals the treatment to which the hair has been subjected—a suggestion for the writer of detective fiction

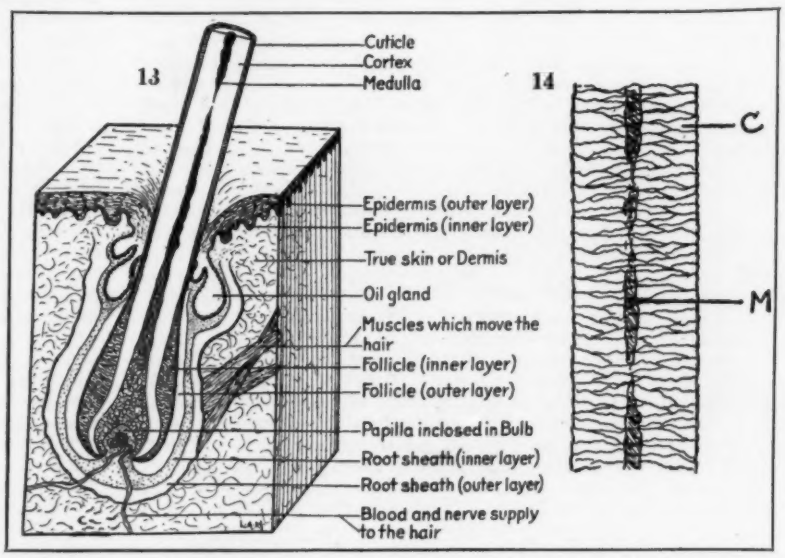
illustrated on page 112 is employed, and the greatly magnified image thrown upward on to a scale.

Not only are the forms and sizes of the pigment granules available as identification criteria, but also their color values and color depths. Some are dark brown, others yellow, others reddish. By the use of illumination, for the microscope, of standard color, direction, and intensity, accurate comparisons of color values of very minute fragments of hair shafts can be made. Because of the magnitude of the enlargements used for the study of pigment granules, photomicrography can not be successfully employed, except as a means of showing general features of hair coloration.

Work upon the pigmentation of hairs came about as a result of examination of a large series of animal hairs made by the author from 1915 to 1918. It was the possibilities of the forensic application of the study of mammal hairs in connection with the fur industries which led to a preliminary survey of samples of human hair of different color, and particularly from individuals of different races. At the present time it can be said that identifications of hair samples, and especially of minute fragments, are upon grounds of much greater trustworthiness than ever before. Minute criteria, of the sort discussed, have already proved their worth as aids in analyses, in forensic, archaeological, industrial, and purely scientific investigations.

The medulla and cuticular scales likewise show characters whose variations in form, size, and relationships also afford valuable aid in analysis. Fig. 14 shows the typical form of the cuticular scales and medulla of the average human hair. These two elements undergo certain fairly definite modifications in the hair of different races, in hair of different colors, and sometimes in the hairs from different individuals. Studies in individual hair variation, with regard to the microscopic structural elements of the hair shaft, will well repay those engaged in medico-legal work.

One of the earliest usable series of data for the separation of peoples into races on the basis of minute hair characters was that perfected by a French professor, Dr. Pruner-Bey, who about 1838 pointed out that the shape of the cross-section of the hair shaft is consistently characteristic of race. By an extended series of examinations and measurements Dr. Pruner-Bey showed that each of the various types of woolly, wavy, kinky, frizzy, or straight hair exhibited its characteristic form of cross-section. The straighter the hair the more nearly circular the outline of the cross-section; the curlier the hair the greater its ellipticity. Thus the straight hair of the Mongols and American Indians presents a circular, or nearly circular, transection, while the woolly hair of the negroid peoples of Africa shows an elliptical one. (See Figs. 17, 18.)



13. Shaft of a single human hair, represented in its place in the skin, a block of which has been cut out. 14. Typical form of the cuticular scales and the medulla of the average human hair

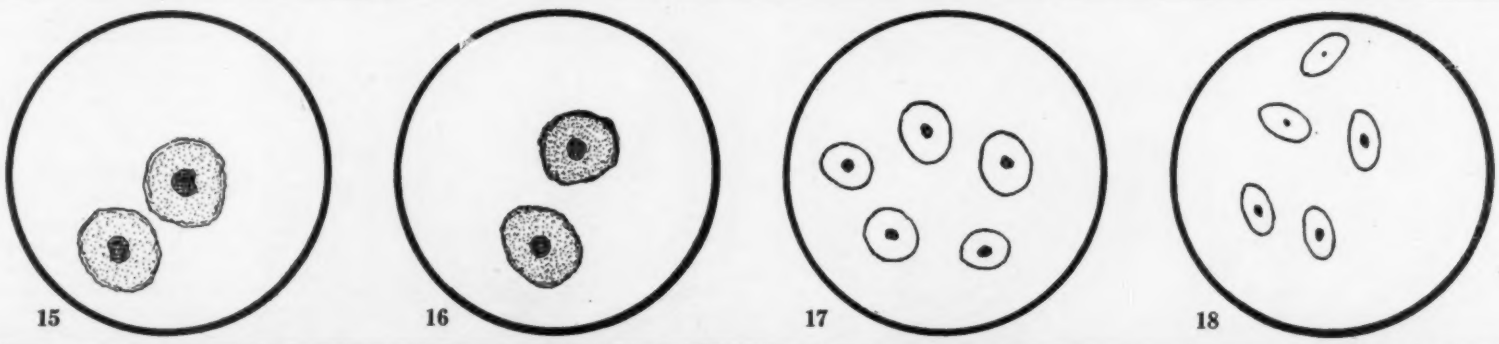
General structure and arrangement in the skin of human hairs

This basis for race classification has been long recognized as a rather precarious one. A slight displacement of the hair shaft under treatment away from a vertical position with regard to the edge of the sectioning knife results in the formation of a distorted transection, and may change a circular cross-section into an elliptical one, or increase the index of ellipticity in a slightly elliptical hair.

It is frequently helpful, or even vital, to know accurately to what sort of treatment a hair has been previously subjected. And here again the microscope can help us, for almost any sort of treatment of the hair registers its effects in some modification of the delicate structures composing the hair shaft. Hence it is that the microscopist can often determine whether samples of hair were taken from the head of a man or a woman, though it must be said that the recent fad of bobbing the hair has worked sad havoc with the reputability of this particular criterion! In general, however, the natural ends of a woman's hair present the appearance shown in Fig. 9, while those of a man's appear as in Fig. 10. If a hair shaft be bent and broken apart its fractured end shows a characteristic and easily recognizable form, shown in Fig. 11. A hair cut with a razor is shown in Fig. 12. These are some of the many separate bits of information obtainable through a microscopic examination of hair fragments. A tabulated series of observations of this sort is of great usefulness to the microscopist, who is called upon to search for answers to exceedingly nice questions, answers which lie, often, awaiting only the proper treatment and examination to make them render up their aid.

Trend of Automobile Design in Germany

A MARKED preference for 6-cylinder in the place of 4-cylinder motors is to be noted in the case of heavy types of car, while the 8-cylinder motor appears only in a few exceptional cases. Motors with overhead valves are being preferred on account of the greater reliability, higher efficiency and considerably lower fuel consumption due to the improvement of combustion chambers thus obtained. A new type of motor has been produced by subdividing the cylinder head and carrying the crank case up close to the combustion chamber, as well as by using steel cylinders and aluminum pistons. Thanks to an extensive use of steel, it has been possible, *e.g.*, in the case of the Mercedes motor, to reduce metal masses in the cylinder head, thus allowing such motors to be submitted to heavy overloads. Moreover, there is a wealth of improved carburetors intended to deal with inferior kinds of fuel (heavy oils), fuel economizers, ingenious combinations of the igniter, starter and lighting dynamo, new and improved accessories of all kinds, etc., and much space at the recent Berlin show was allotted to these devices.



15. Cross-sections of a reddish-brown hair, naturally pigmented. 16. Similar sections of hair dyed with henna. Note that in hair thus artificially colored the cuticle is stained. 17. Sections through hair shaft of American Eskimo. 18. Similar sections in the case of South African Bushman, showing increased ellipticity of the hair with increased curliness

Other details of hair analysis with which the microscope enables us to deal

A Second Pompeii

Remains of an Ancient Metropolis Discovered Beneath the Cellars of Mexico City

By Fred Gilman Jopp

IS there a second Pompeii under Mexico City? Does the largest city of the southern republic have, as a foundation, the roofs of an ancient city of which it knows nothing? Recent excavations have indicated that this surprising possibility exists.

While doing some construction work, one of a party of workmen in the heart of Mexico City suddenly disappeared from view. In the process of rescuing him from the deep pit into which he suddenly fell it was discovered that he had literally fallen into another town. Naturally, great excitement at once prevailed and crews of workmen were at once brought to the place and started on the work of removing the ground level of the modern city.

Left: The stone serpent that guards the entrance. *Right:* The bake-oven of bygone years

Some of the sights seen on breaking through the lower crust of Mexico City

When this was done, and the existing earth removed, it was found that a complete building, in excellent condition, was supporting the supposed solid ground. Walls of rock, not a bit crumbled, divided the house into rooms and passageways of various sorts and depths. Tiled floors, comparable to modern tiled floors, were found intact, and other elements of building construction indicated that the builders knew as much of the principles of construction as modern contractors and architects.

Most characteristic of the builders of the ancient city were the carved stone images found in the walls and about the floors in various places. Of these the large stone serpent which guarded the entrance is probably most noteworthy. This huge affair has been carved out of the hardest stone with an exactness that would do credit to a marble worker of the present day. Detail to the extreme is to be found in this figure; yet the instruments with which it was fashioned must have been altogether crude.

In another place a complete bake oven in perfect condition, built of adobe bricks, was unearthed. According to scientists, the presence of the bake oven would indicate a fairly high type of civilization among the residents of the mysterious city.

A pile of "nails" for use in further construction work is of great interest. These consist of stones, pointed artificially at one end. A pile of hundreds of these is surprisingly uniform. To fashion them from the hard rock of which they are made must indeed have been a tedious task. Apparently the inhabitants had intended to do further building, for there were many of the "nails" stacked up in a pile, ready for use.

The bricks used in the walls are of two kinds: first, those made by chipping rocks into regular shapes and, second, those made of adobe mud. In the case of the bricks made of stone, the walls are frequently built sloping back instead of straight-up, evidently to avoid a cave-in or slide. The walls are extremely thick.

Now that this much has been unearthed, Mexico City residents are wondering what lies under their own property. Is it possible that a whole underground city is there waiting to be uncovered? Or is the ruin that has been discovered simply that of an ancient Mexican dwelling that has been gradually covered up and forgotten? Advocates of the latter theory cite the recent finding of a complete boat under a San Francisco city lot as support for their theory. Many, however, are equally positive that under the modern city lies a second Pompeii, waiting for someone to dig it up again. And still others, who take little interest in the situation one way or the other, are speculating about a more practical question. They are wondering just how secure the foundation of their property is. The possibility of living over an ancient city, with one's dwelling supported only by wedged earth, is not exactly conducive to the most comfortable of feelings.

A view down into the excavations of the old city being uncovered under Mexico's capital

Quantum Theory of Color Vision

IN a recent number of the *Proceedings of the Royal Society* (London) Mr. J. Joly, Sc.D., F.R.S., has an important paper on *a quantum theory of color vision*. Introducing his paper, the author says that he takes the view that the sensation of light is in every case stimulated by the action of photo-electrons set free in the retina. Further, the energy of the photo-electron being proportional to the frequency of the light, the strength of the stimulus produced is the all-sufficient origin of the color sensations. That color is entirely a cerebral phenomenon is evident. Light, visible and invisible, consists of a uniformly graduated series of wave motions or energies. There is nothing to distinguish one part of the spectrum from another save the difference of wave-length or frequency. But objects in nature react differently toward these waves, absorbing some, reflecting others, and so the selective effect of natural objects toward light has discovered to the organism a means of improving on monochromatic vision: a means of distinguishing objects by their selective absorption and reflection. Our color sensations were developed solely for this purpose and solely under the influence of the light reflected by natural objects. Hence a limited number of fundamental sensations being the simplest, if not indeed the only, way of securing the desired end, we should expect that these sensations would be developed so as most effectively to interpret the frequencies met with among natural objects reflecting solar light. The evolutionary attainment of three highly developed color sensations according to the extreme and mean regions of the spectrum is the result. Color sensations, *i.e.* (white) red, green, and blue, were evolved, whereby the whole gamut of the spectrum can be dealt with.

The conclusion is reached that the number of spectral quanta converted to electronic energy and thereby rendered capable of exciting vision is controlled by the light absorption and bleaching of the visual purple (or substance possessing a similar spectral absorption curve). The quanta, increasing in energy from the long to the short wave-lengths, stimulate two, three and four fibers of the cone according to their energy, as shown by the color sensation curves. The simultaneous stimulation of two fibers is attended by the red sensation; of three fibers by the green sensation; of four fibers by the blue sensation. The unit of luminous stimulus is the nerve discharge of one fiber. No color sensation is associated with this stimulus.

The relation of luminosity to color sensation is, therefore, according to the author's theory, as follows: Luminosity is the more primitive sensation, and at first was associated entirely with rod vision. The evolution of the cone brought in multiple stimuli, and the sensation evoked became correspondingly complex. The basal luminous sensation remained, excited as before by a nerve stimulus from the retina, but it was accompanied now by a new and additional sensation, that of color.

Color sensation necessarily involves luminous sensation. It necessarily involves it because the energy is there which excites it. The converse proposition is not, however, true. It is not true because there may be insufficient energy to excite color sensation. The separation of color sensation from luminous sensation is therefore impossible.

The quantum theory occupies a large place in modern physics; but it is doubtful whether any of its applications are of greater interest than this one.

Meteorite Glows for Three Hours

A GREAT meteorite, three feet in diameter, fell on a hill near Tammin in Western Australia on the night of September 2. It continued to glow for three hours after striking the earth. The light was strong enough to show the neighboring trees.

Measuring in Millionths

The Latest Recording Ultramicrometer, a Device with Instantaneous Action

AMONG the interesting apparatus displayed for the first time at the recent British Association meeting (September, 1921,) was the recording ultramicrometer developed by John J. Dowling, M.A., of University College, Dublin. The principle underlying this device is best understood from the following experiment, but it must be stated that the particular valve circuit here dealt with is only one of several that may be utilized. For certain purposes other arrangements are more suitable.

In Figure 1 the coils XY, YZ are small pancake coils suitably placed by trial so as to make the apparatus function as described below. The condenser C is formed

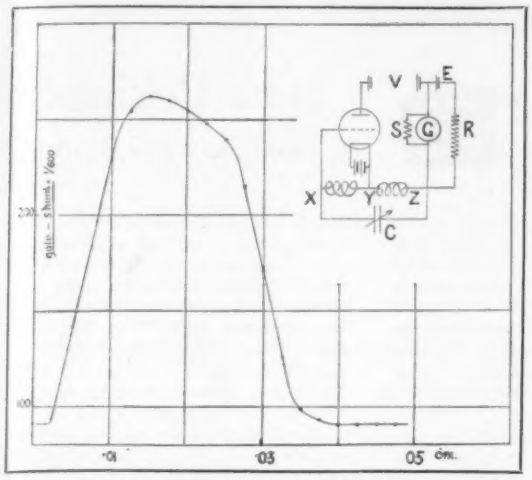


Fig. 1. The experiment upon which the action of the micrometer is based

by two small disks tuned reasonably true. The relative motion (normally) of these produces alteration in the capacity which causes corresponding changes in the anode current, and it is this anode current variation which is measured by the galvanometer. By means of the "zero-shunt," consisting of a few cells E and the resistance R both in parallel with G, it is possible to employ a sensitive galvanometer to record only the *changes* in the anode current, I, in the neighborhood of a particular valve thereof. If the resistance R is great compared with the galvanometer resistance, it is easy to see that practically all the difference, dI, of the anode current, I + dI, from the "standard" valve will go through G. Very minute changes in I are thus recorded.

The curve represents the variation in the anode current as C is changed—the variation in C being expressed in terms of the readings of a micrometer screw which moves one of the plates. It is obvious that over two parts of the curve the variation of I with the displacement is a simple linear one. This is a fact of great importance in simplifying the employment of the device. By employing the "zero-shunt" the galvanometer shunt S can be dispensed with, and, if the apparatus is functioning *anywhere* on one of the straight parts of the curve, the extraordinarily minute displacements of the condenser plates are recorded by the galvanometer. In the example shown a displacement of less than .0000001 centimeter was detectable.

The apparatus, when adjusted to very high sensitivities, has to be screened as is usual in wireless work, but it is quite steady and recovers instantly from an accidental disturbance. The "inertia" of the galvanometer is probably a large contributing cause of this steadiness.

The applications of the device already worked out include the following, and patents have been applied for covering these.

Both in the physical laboratory and in engineering the measurement of minute strains, displacements, expansions and the like can be carried out with a degree of refinement altogether out of proportion with the simplicity and reliability of the apparatus. All these can be made from a distance and can be recorded by a recording galvanometer if desired. Both transverse as well as longitudinal strain has been measured on quite small specimens (2 inches by ½ inch square) and thus *all* the elastic constants determined.

Weighing devices have been developed. For example, a balance weighing 200 grams to the nearest milligram was shown in which the micrometer device was used to indicate, instantaneously, the difference between the weight of the substance required and the nearest whole number of grams. To use it, weights are removed from one scale pan until the sum of the remaining weights *plus* the substance differs by a fraction of one gram from 200 grams. The scale reading then directly records the outstanding difference in milligrams. A balance acting on this principle is dead-beat in action and enables an accurate weighing to be obtained in a few seconds instead of several minutes—a great desideratum in many cases. A suitable modification of the "spring" enables weights of, even, tons to be determined with equal percentage accuracy.

On similar lines an apparatus is being developed to enable minute variation in gravitational force to be observed. The decrease in weight of a kilogram when raised one meter can be readily observed.

If one of the condenser plates is carried on a flexible diaphragm, minute pressure differences are recorded with great ease. Using a rubber diaphragm one millimeter thick, pressures of less than .0001 atmosphere are measurable to one per cent. Such an apparatus, a rough model, was shown.

Incorporated in seismometers such considerable magnification is obtainable as to make it possible to introduce enormous damping. Much smaller instruments are likewise possible, while great sensitiveness and its concomitant delicacy of adjustment are no longer so necessary in the seismometer instrument itself.

The measurement of the "growth pulses" of plants is another problem to which the apparatus has already been applied (*Nature*, June 23, 1921) and, in its most sensitive form, it promises to yield valuable results in this as in other fields of research.

The foregoing particulars are in respect to the actual apparatus exhibited at the meeting of the British Association in Edinburgh. As a matter of fact, however, the inventor has obtained much higher sensitivities with the apparatus set up in the quieter surroundings of the laboratory. Although the micrometer itself does not appear to be much affected by vibration, etc., the condenser portion cannot always be made rigid (*e.g.*, a pressure gage) and this is then liable to cause fluctuations if disturbed. Another point, already mentioned, is the necessity for proper shielding of as much as possible of the apparatus when very sensitive.

For calibration at these high sensitivities the device shown in Fig. 2 is used. The two 10-centimeter circular condenser plates (a) are carried by the ebonite collars (b) by means of suitable levelling screws and springs. The steel rod (c) passes through large holes in the collars and disks, but the former are held tightly on the rod by sets of three set-screws (d) which meet the rod on two circles 5 centimeters apart. The rod is screwed vertically into a heavy base and carries a small table above. Any desired small compression can be given the rod by placing weights on the table; ½ kilogram actually causes 5 centimeters of the rod to contract .000001 centimeter, and the condenser plates are therefore moved just this amount.

Pressure gages of moderately high sensitivity are calibrated by the drop in pressure along a 1-centimeter tube when a current of air is drawn through at a measured rate. Pressure differences ranging from 1/10 to 60 dynes per square centimeter are readily obtained in this way, and there are no troubles from temperature effects. In this way several gages all made with stout rubber diaphragms one millimeter thick have been tested. As regards constancy of zero, steadiness, quickness in response, and sensitivity they leave nothing to be desired, and each one can be varied in sensitiveness at will by shunting the galvanometer.

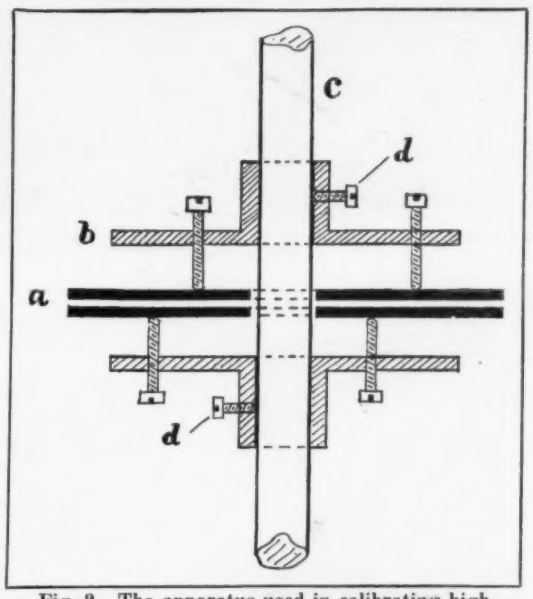
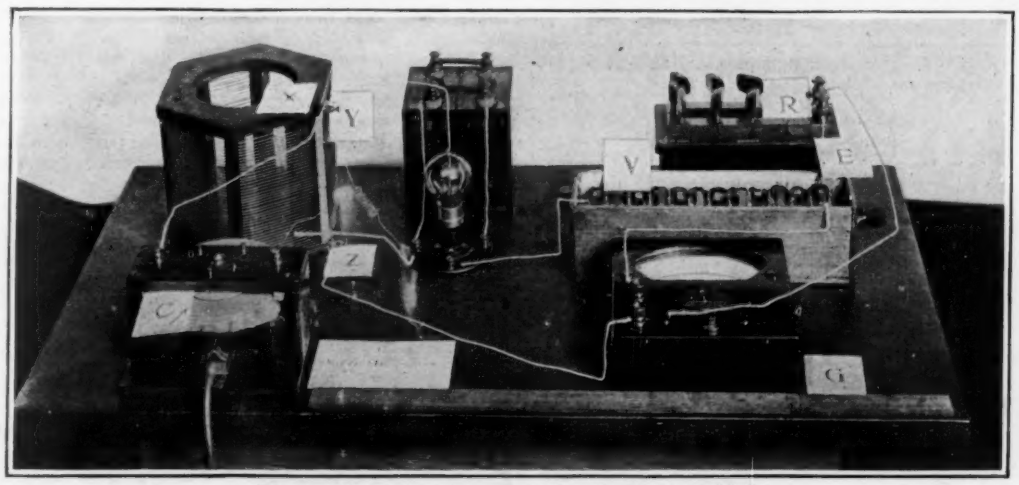


Fig. 2. The apparatus used in calibrating high sensitivities

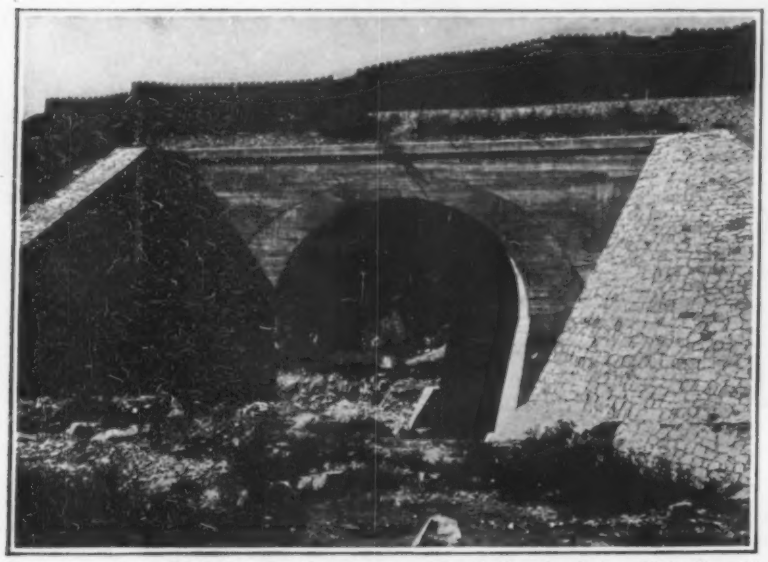
One or two points remain to be dealt with which arose in course of discussion at demonstrations. Mr. Dowling has tested the sensitiveness of micrometers at intervals while the valve circuit was kept in oscillation and also from day to day; in every case the sensitivity was found constant, provided that the filament battery was in good condition. Similarly, after "starting up" a minute or two suffices for steady conditions to be reached. The inventor attributes this steady behavior to the valves being run at low voltages.



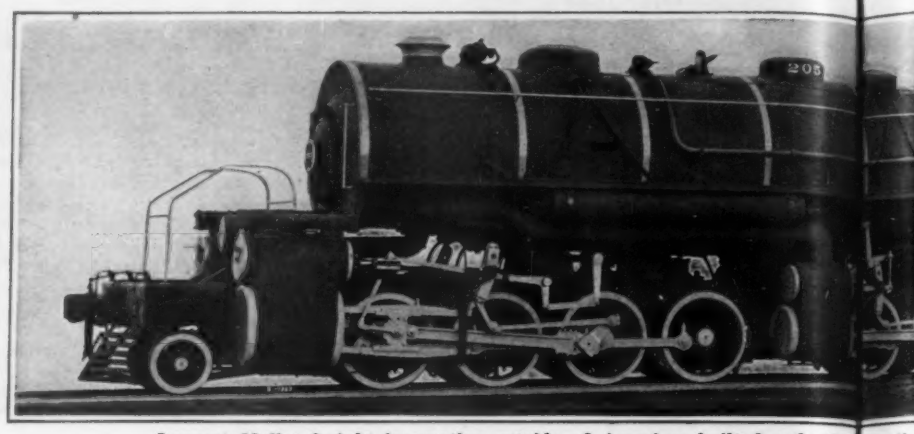
The Dowling ultramicrometer, completely assembled

Resources of Jugoslavia

THE *Revue des Balkans* states that Jugoslavia's immense resources of prime materials have been very little exploited up to the present because of lack of labor and capital. The wood industry holds first place in the country, one-third of which is covered with forests. The textile industry is still in a primitive condition. It has some 60,000 spindles and 2500 looms. The clothing and carpet industry are important in Siberia, but these enterprises are suffering especially from lack of cotton. The iron industry is very little developed. The annual output of raw iron is 2,000,000 tons. The deposits of magnesium in Lublja have not yet been exploited, although the annual production is estimated at 45,000 wagons. The sugar industry is well developed. The six sugar refineries of the territory obtained from Hungary can practically satisfy the needs of Jugoslavia.



Concrete culvert, built to pass the storm waters during freshets. Note the old Chinese wall on the crest of the hill



Largest Mallet freight locomotive outside of America; built for the Pek railw

中華國

The Peking-Suiy Rai

A Road Surveyed, Constructed perate

IN these photographic illustrations of the roadbed, rolling stock and locomotives of the Peking-Suiyuan Railway in China we have concrete evidence that the Chinese, who antedated many of the inventions, discoveries and engineering constructions of modern days, can become thoroughly efficient when they set themselves to master the principles and practice of the most up-to-date engineering accomplishments of our times.

We ought not to be surprised at this revelation; we ought rather to be surprised that the modern industrial awakening of China did not happen long ago. For so far as history and archaeological evidence are concerned, the Chinese were not only among the earliest, if not, indeed, the very earliest, to construct engineering works, which we are apt to consider as modern in their conception, but they built upon such a scale that many of their structures would be notable for their size even in the present day. It is believed that the first iron chain suspension bridge was built by the Chinese, and it was built so well that it is in use today. Centuries ago they crossed some of their greatest rivers with stone bridges which are still in good condition, one of these being over 4000 feet and another considerably over 5000 feet in length. They were among the earliest to appreciate the merit of the stone arch, and they built it on a scale that was ambitious for those early days; and some of their later stone arch bridges, notably the one illustrated in our issue of November, 1921, possess decided architectural fitness.

The Peking-Suiyuan Railway should be particularly interesting to Americans because of the fact that it was built by engineers sses, ju received their training at American univ structi ties. The greater part of the line was tely re structed under Dr. Jeme Tien-Yow as e line i engineer. Dr. Jeme graduated from Ya 3 per c 1881 and rose to be the most prominent good j nese civil engineer. On his death a few y gineers ago he was succeeded as chief engineer insure Mr. K. Y. Kwong, who graduated from us it Massachusetts Institute of Technology hich th 1881. The influence of the training of t avy fre engineers is seen in the character of hich ha Peking–Suiyuan Railway, as shown in nts fr accompanying illustrations. The roadbed, s a la last, ties, joint fastenings, et cetera, are d one essentially of the American type, and, in t be fo would pass muster on the best of our rently roads. Also it is evident that the maintena ss pr of-way engineer and the section foreman e levee their gangs are efficient, for the line has s case appearance of receiving careful attention, nkmen ballast is deep and ample and the alignete, w and surfacing of the rails appear to be e on. A thing that could be asked. the m

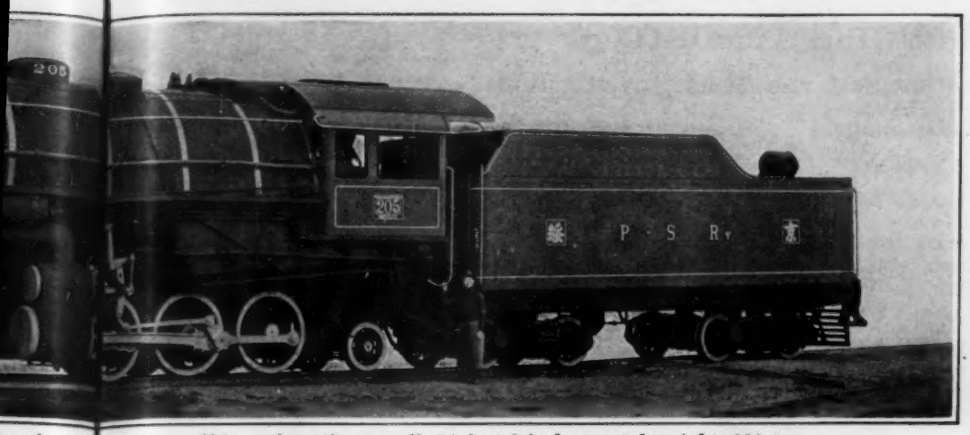
The Peking-Suiyuan Railway connects e porta the Peking-Mukden and the Peking-Han The fi Railways at Fengtai, runs along the west eking-K of the Chinese and Tartar cities of Pe ngth, w and then extends in a northwesterly direc 09. T to Nankow over the West Hills, via Nan ropriate Pass, to Kalgan, and thence to Fengchen the P Suiyuan. The total length of the line is e payn miles. There is also the Mentowkow bra pital f which leaves the main line at the north ailway corner of the city of Peking and runs west mmuni to important coal deposits 16 miles dist e line

The country through which this rail king r

Inspection car rounding a curve in the line. Just beyond, the line intersects the Chinese wall

Note the deep broken stone ballast and bank protection against freshets

This fine bridge was designed by Chinese engineers, fa in An



or the Pek railway, China. Length over all, 94 feet 9 inches; total weight, 320 tons

-Suiy Railway of China

structed perated Entirely by the Chinese

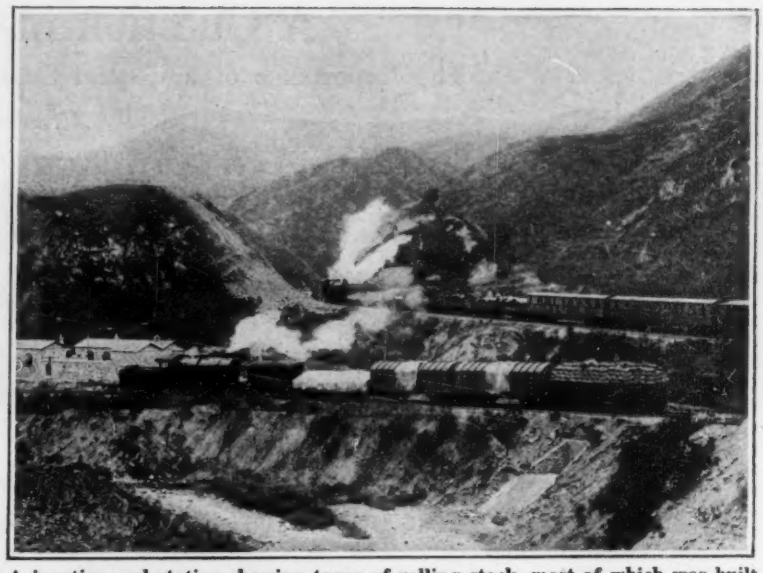
有鐵路

engineers sses, judged from the standpoint of railway rican univ struction, varies from fairly easy to mod- line was tely rough, with some heavy work where -Yow as e line is carried across the West Hills on a from Ya 3 per cent grade. It called for the exercise prominent good judgment on the part of the locating h a few y gineers and necessitated some costly work f engineer insure the permanent integrity of the line. ated from us it will be evident that the river along Technology hich the line was developed is subject to ining of t avy freshets, as shown by the precautions racter of hich have been taken to protect the embank- shown in nts from errosion and undermining. There roadbed, s a large amount of riprapping to be done, etera, are d one of our views, for which space could , and, ind t be found on this page, shows what is ap- of our r ently the Chinese substitute for our mat- maintena ss protection, as used in connection with foreman e levee work of the Mississippi River. In line has s case the bed of the river adjoining the em- ttention, nkment is protected by large slabs of con- he align ete, which should afford a durable protec- to be e n. Attention is also drawn to the character the masonry as shown in a culvert and at onnects e portal of one of the tunnels.

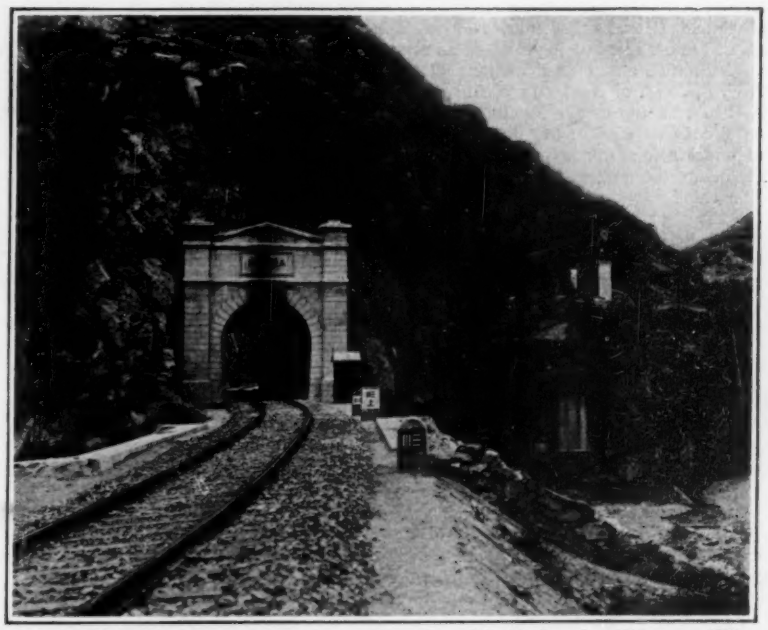
king-Han The first stretch of the line, known as the he west eking-Kalgan section, which is 122 miles in s of Pe gth, was commenced in 1905 and finished in rly dire 09. The funds for its construction were ap- via Nan propriated yearly out of the surplus earnings engchen of the Peking-Mukden line, after deduction of e line is e payments of the six months' interest and kow bra pital for the loan. As the Peking-Kalgan e north ailway was nearing completion, the board of uns west ommunications considered the extension of iles dist e line from Kalgan to Suiyuan. The under- his rail king received imperial sanction in 1909 and work began in the following year. The length of this line is 235 miles.

Revenue from the freight on this line constitutes about 75 per cent of the earnings. The other 25 per cent is received from the passenger business. The preponderance of tonnage is toward Peking and the Fengtai connection with the Peking-Mukden Railways. This affords the advantage of a down-grade haul over the heavy 3.33 per cent grade across the West Hills. The larger part of the freight consists of agricultural and pastoral products. As we have already stated, this interesting railroad is entirely the work of the Chinese. Thus the bridges for the line were largely fabricated at the Shanhaikwan bridge works of the Peking-Mukden Railroad. The 85-pound rails and joint material came largely from the Han-Yeh-Ping steel works at Hankow. Much of the other material, such as switch stands, has been purchased from time to time in America. Most of the passenger and freight car equipment on this line was built at the Tongshan shops of the Peking-Mukden Railway, although a relatively small amount is of American manufacture.

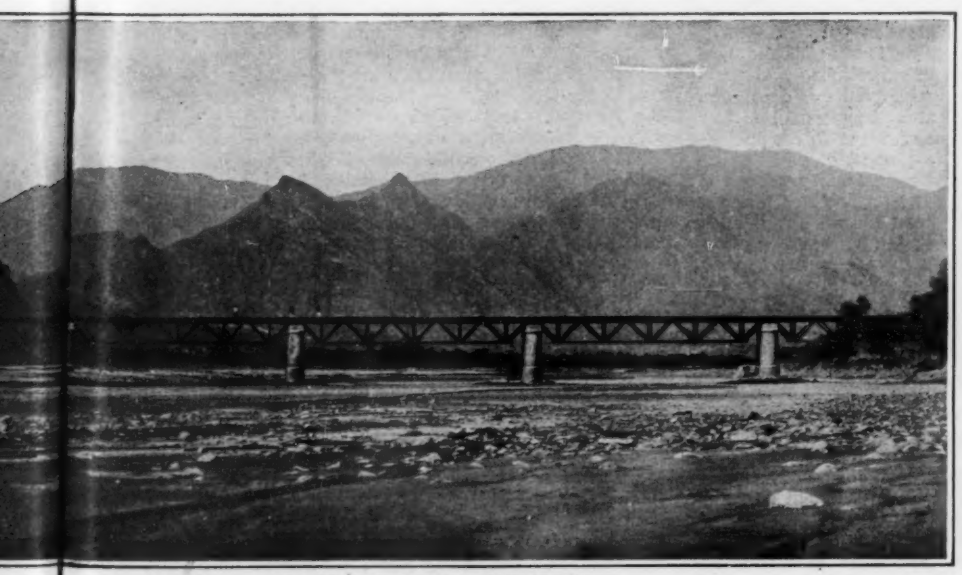
Most of the locomotives are American built. Chinese railroad men on this line are justly proud of the fact that the heaviest and most powerful locomotives, not only in the Far East but in all the world outside of America, are to be found on the Nankow grade. These engines, as shown in the illustration at the head of this page, are of the Mallet type and were built by the American Locomotives Company, who have already despatched several of them to this up-to-date Chinese railroad.



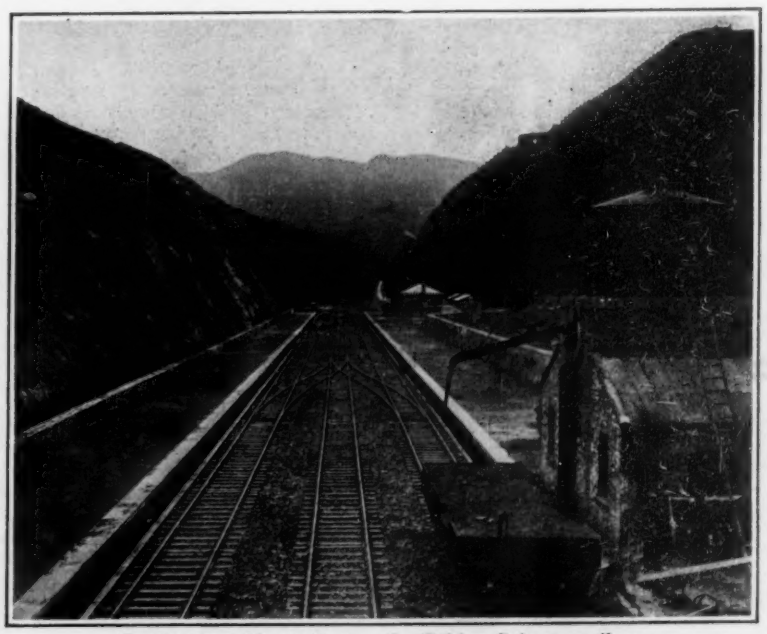
A junction and station showing types of rolling stock, most of which was built in the Chinese car shops



The Peking-Suiyuan railway was surveyed and built by the Chinese. This tunnel portal shows the excellent character of the masonry



eers, fa in American shops, and erected entirely by Chinese labor



Typical wayside station on the Peking-Suiyuan railway

A Question in National Resources

The Importance of a Central Station for Peat and Muck Investigations

By Alfred P. Dachnowski

Physiologist, United States Bureau of Plant Industry

TO know anything that is today of fundamental interest about peat deposits, they must be analyzed in three coordinates—in their space and time relations and in their energy value. The estimates which have been made of the areas of peat and muck land distributed over the United States are quite unlike (*Soil Science* 10: 453-465—1920) but the stratigraphic method—indicating the nature of the plant remains and the order in which layers of peat material lie upon one another in the deposits—offers the basis for a careful consideration of the acreage and geographical distribution of peat deposits which more properly constitute the reserve of profitable future farm land. The stratification of peat deposits, and the animal and plant remains imbedded in them, is moreover of high importance to geologic, climatic, and biologic research (*Botanical Gazette* 72: 57-89, 1921). Although the specialists engaged in these studies are few, their investigations are of much value, since they indicate the relative age of these deposits and the time periods in the past history of the country, when the beds of organic material were formed. The different types of peat material which supply the essential criteria concerning the physical, chemical, bacteriological and other merits of workable tracts of peat and muck can now be studied as sources of energy in coordinated effort and without difficulty (*Bulletin 802, U. S. Dept. of Agriculture, Bureau of Plant Industry*, 1919). Some of the localities have been indicated (*Botanical Gazette* 72: 61, 1921), near which layers of peat material are displayed in typical form at or somewhat below the surface of representative peat deposits.

The chief purpose, if not the most important one of all in the problem of peat and muck lands, however, is to enable one to form some reasonable estimate of the future course of practical usage, the future agricultural and industrial development of peat and muck land, so far as that is governed by economic conditions. Such an estimate must also be based on one's knowledge of the profile structure of these deposits, the materials of which the different layers consist, and the field conditions that can be seen in operation at the present time or in the near future. In attempting such forecasts laboratory studies, experimental results, and statistical data, including crop production and demand, are unquestionably an important aid. One of the greatest advantages which the future may be expected to have over present information concerning the relative value of peat and muck lands will consist in the greater accumulation of comprehensive, exact data. The better insight as to the kind of information collected will help to distinguish the important from the unimportant peat-lands and will direct attention to the methods most worthy of handling these deposits.

In relation to the common welfare the problem of a safe and profitable utilization of peat and muck lands is a serious one. These areas represent not only the last unused natural resource of the country in both land and raw material, but the prosperity and well-being, the maintenance of many rural communities in states having a large acreage of peat deposits depends upon the possibility of increasing the usefulness of these "waste" land areas. Economic and social considerations demand a keener interest than has been enlisted thus far in helping to meet and solve the peat-land problem to the fullest degree possible.

Peat-Land Crop Possibilities

In almost all relations between larger private enterprises on peat lands and public service an unconscious movement is seen toward cooperation. There is a growing conception of the futility of individual effort to encompass the necessary knowledge and the measures needed for the commercial expansion and rapid development of peat and muck areas. Experience has shown that many complications are inherent possibilities. Exploitation of peat deposits has for so long outrun an understanding of their structural differences and relative value for live stock and dairy farming, for general crop management, and for the manufacture of peat products, that even among laymen the operations and results on most peat lands are known to fall far short of their possibilities. Peat-land agriculture is not different from a manufacturing plant; both should know at frequent intervals just what progress they are making and what changes must be made to avoid damage.

It does not seem necessary to advance many arguments as to the value of collecting, accumulating and disseminating fundamental information relative to the agricultural development and management of the immense and varied peat-land resources. The farmers themselves see the need of more complete knowledge of how to get better crops from peat and muck soils, and they are willing and ready to adopt a coherent program of drainage, of crops and new plant varieties suited to these soils and to the markets, and of properly balanced fertilizers for the particular types of peat deposits, to replace the guess work and uncertainty. A beginning should be made by applying on selected peat areas the scientific principles and methods that come from the laboratory and the field plots of a central station for peat-land investigations, so that definite information may be given on the underlying causes of success in these matters. The trend is decidedly toward a larger use of peat and muck land, consequently to a more varied and diversified agriculture. Peat deposits, therefore, must be given their proper place in a system of farm management. That this should be done within the next few years is particularly vital to the tendency toward an organized agriculture. To meet this new movement the peat-land issue should be faced with the willingness to consider most carefully peat-land utilization with respect to the country's future requirement. The answer to the problem of both producer and consumer lies in making the better quality of peat and muck land work to better purpose. The production of highly speculative special crops, such as celery, onion, and mint, appears to be a success only on the *heavy* peat soils, on deposits which show a profile structure of aquatic types of peat alternating or intermingling with more fibrous layers. On the other hand, the *light* peat soils from marsh, bog and forest types of peat

THE peat deposits of the United States present today one of the great fields for productive work in a wide range of activities. There is a continuous demand for definite and significant information regarding the usefulness of peat and muck lands. The interest is widespread and there is a pressing demand for a thorough consideration of these areas by state agencies, communities, and private owners. A great variety of important problems confront the investigator and the practical man as well. Mr. Dachnowski in this article states some of these, and indicates the direction in which he believes a solution to lie.
—THE EDITOR.

appear to meet the demands of diversified farming. It is obvious that these fundamental differences in types of peat form a sound basis for systems of crop management and for industrial plans of developing peat deposits. They represent differences in potential energy which should be known from various standpoints of scientific research. The years of experience of the practical peat-land farmer are valuable points of departure. The practices of the competent and successful farmer are at present the only guide of value to the inexperienced prospective producer on peat land, whose observations are confined to crop varieties and practices on mineral soils. But if distinct and far-reaching progress is to be made in the intensive and extensive utilization of the different peat and muck lands, then the establishment of a central station for peat and muck investigations becomes a fundamental prerequisite.

The lack of information concerning the nature of peat deposits and the properties of the raw materials injures the standing of the peat-land industries with the general public. Both have been left a prey to misinformation, and the road is still open for the promotion of impractical fuel and fertilizer operations. There are many obstacles in the way of attainment, and the problem is peculiarly difficult. The process of dewatering the raw material, the seasonal nature of the production, the distribution of suitable types of peat and the varying volume in different deposits raise problems that make an accurate estimate for the future a difficult task. However, this should not deter manufacturers of peat products from going at the question with the determination to get the best solution possible. It is to the greatest interest of all that these industries should be stable and fundamentally and economically strong. The margin of profit is certainly more available in the coming years if the basic materials, their distribution and properties are known far more intimately than heretofore, and if well-defined standards might be set up and made available for use by the whole industry. Abler operation and better results can come only from a thorough investigation of the subject. This procedure would not only help to eliminate misinformation and place the peat-land problem upon a higher plane, but also it would bring an element of stabilization beneficial to all activities in peat and muck. It would meet with the approval of banking institutions, state security commissions, farm loan boards, and insurance companies who, at present, find themselves constantly handicapped in the extension of financial aid by the lack of scientifically determined criteria of peat-land values.

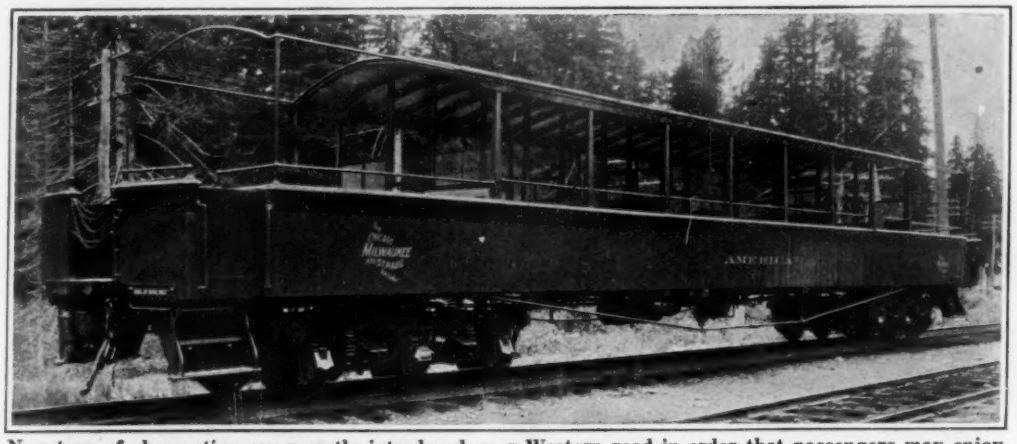
Power from Peat Lands

In the states in which peat and muck areas are most extensive a cooperation between agriculture and industry appears to be the only feasible method of increasing the usefulness to a community of its peat lands. The striking feature in this cooperative movement of the immediate future is the fact that the state and the community, the farmer together with the manufacturer, must play a part. Just how this cooperation shall be effected and how it may be brought about is a problem of no small concern. It needs a very thorough consideration and an able guidance, for it is a question of values and the proper functioning of different agencies in an organized enterprise. The generation of power at peat deposits and the transmission of this power in the form of gas or electric energy is looked upon as one of the coming engineering possibilities for economy and cooperation. This project lies at the basis of several superpower surveys which different governments in Europe are now making with the view of the application of power to large-scale agricultural and industrial activities. There are peat deposits in several states in this country which offer a profitable location for power projects complementary to farming and manufacturing purposes. For this reason investigational, experimental and statistical activities must be undertaken on a larger scale than that done heretofore. A national institution for peat investigations is the right place to undertake this work, to sift the information, and to use it properly for the benefit of all. It would remove a vast amount of duplication by many states and private agencies now gathering uncoordinated data, and it would result in a saving of public funds and of needless expense. There is no justification for the assumption that research in peat and muck lands can be suspended or dispensed with entirely. The leading countries of Europe have materially increased their appropriations for this work, for there, as elsewhere, peat deposits are the future granaries for increasing populations and rapidly growing industrial centers. The volume of literature from these stations sufficiently denotes that the personnel is devoting its entire time and attention to special problems in the technology and plant industry of peat lands The knowledge and experience emanating from these scientific and unbiased agencies leads to conclusions in which all may have confidence.

There is, therefore, a direct relationship which a central station for peat investigations bears to the future development of peat and muck land. This is so important that the value and functions of such an institution cannot be stressed too strongly. Its public service is to discover what are the best things in science and practice as applied to peat-land agriculture and peat industry. College and station workers are looking more and more to a national institution for peat investigations for correlation, suggestions and assistance on many of these matters. The work done in the past is insignificant compared with what may be accomplished in the future. The foundations are already laid. Efforts in this direction have not been heralded by wide publicity; the work has been done quietly but none the less effectively. But there is need of further support in enlarging the work to a more unified national peat-land policy in order that it may represent the best thought of the manufacturer, the farmer and the scientist under the best practices which can be developed.

Something New in Observation Cars

IN order that its passengers may enjoy the scenery to the utmost, the Chicago, Milwaukee & St. Paul Railway has recently introduced the new open air observation car shown in the accompanying view. The car, it will be noted, is open on the sides above the top of the seats. The seating arrangement follows the general lines of a sleeping car, and a windshield is provided between each section. The roof covers that portion of the car taken up by the seats, leaving an uncovered section some eight feet long at each end of the car, as shown.



New type of observation car recently introduced on a Western road in order that passengers may enjoy the scenery to the utmost

Rapid Transit in the Telegraph Office

SENDING telegrams by compressed air is the latest innovation in American telegraph methods. Greater speed and efficiency and perfect accuracy are the reasons given by the Western Union Telegraph Company for its recent expenditure of millions of dollars in building underground pneumatic tubes radiating from its central operating rooms to its numerous branch offices in the larger cities of the country.

One of the most extensive and costly pneumatic tube plants has just been completed by the Western Union in San Francisco, after an outlay of nearly a quarter of a million dollars. Messages handed in by patrons at the branch telegraph offices in that city are no longer telegraphed or telephoned to the main office, but are now enclosed and locked in cylindrical cartridges and deposited in pneumatic tubes, through which they are rushed by compressed air direct to the top floor of the central office, where connection is made with the great network of transcontinental wires. Telegrams coming from all parts of the country to firms in the local branch office districts are dispatched throughout the city in the same manner when received in the main office, a double line of underground tubes being laid to carry messages in both directions.

Many of the tube lines are over a mile in length, and the San Francisco installation is composed of thirteen miles of this copper tubing encased in creosoted wood ducts several feet under the surface of the downtown streets—nearly enough to run a boundary halfway around the city.

The accompanying views show the magnitude of the main office terminals of a battery of these tubes. Each line shown in the picture has its other terminus at a distant branch office in some section of the San Francisco business district. On the right-hand side of the aisle are the incoming tube lines, from which messages sent in from the branch offices are constantly being discharged into a system of automatic carriers by which they are deposited a few moments later at the telegraph keys and before the operators of the amazing automatic telegraphing typewriters — the multiplex machines, already described in these pages.

The multiplex system, an orderly maze of glass-enclosed instruments, relay switches, whirling brass disks, flashing lights, rapidly clicking typewriters, and reels of perforated tape, sends eight messages simultaneously over a single wire, the typewriters at the receiving end being operated electrically by the sending operators seated at keyboards across the continent. In the San Francisco office the multiplex system carries messages directly to and from the great wire centers of New York, Chicago, St. Louis, Kansas City, Dallas, Denver, Salt Lake and the important cities of the Pacific Coast. It is stated that 70 per cent of the Western Union's total traffic is handled through these machines either completely or at some stage of its transmission; and the advantages claimed for it, as in the case of pneumatic tubes, are accuracy, speed and efficiency.

The central office terminals of the outgoing local tube lines are shown in the second view. Here the messages received from hundreds of wires are carried without a moment's delay over the automatic carrier system and shot into the tubes, where they disappear with a sharp hiss of released air to begin their journey through the copper tubes beneath the street traffic of crowded thoroughfares, emerging one or two minutes later at a distant branch office.

Copyright, Keystone View Co.

Girl despatchers of telegrams with handy directories at hand, and a view in the labyrinth of pneumatic tubes with a belt conveyor at extreme right

A Gas-Light Globe That Will Not Crack

EVERY laboratory knows the virtues of vitreous silica-ware, which can be heated white-hot and dropped into cold water without breaking. But that the same material has uses in the home, the office, and the store is not so well known. A series of opal globes, designed for use with the incandescent gas-light has now been placed on the market in England, which will survive the most severe conditions of heat without cracking. Every housewife who has had trouble with the usual glass globe knows how expensive and dangerous the ordinary form is, with its short life and frequent crackings. And the lighting engineer of the gas-lit store or works has hesitated over installing the admittedly superior "indirect" or "semi-indirect" system because of the expense and danger of the large opal glass bowls necessary.

The new material changes all this. There is absolutely no chance of it cracking through overheating, even if a mantle breaks and the flame impinges direct on the globe or shade. For vitreous silica is silica fused in the intense heat of the electric arc (at a temperature of over 400 degrees F.) and allowed to cool into the many beautiful and artistic forms in which it is available. The great characteristic of this fused silica is that its coefficient of expansion is practically nil. From this cause arises its immunity from damage by sharp changes of heat. We have seen a piece of this material dipped into water, placed wet in a Bunsen gas flame and heated to bright redness, and then suddenly thrown into cold water. No apparent change took place, and this drastic treatment may be repeated indefinitely without the "vitreosil" (as it is called) losing its beautiful glaze or its characteristic semi-transparency. This latter property, which bestows upon light transmitted through it a delightful soft effect, is due to the presence of innumerable minute air bubbles throughout the whole body of the material. The utilization of "vitreosil" for the purpose of gaslight globes and shades is a new departure, and it seems to be a successful effort to bring the new discoveries of science out of the laboratory into the home, where they can serve a real practical purpose.

A High-Speed Crankless Steam Engine

MR. A. G. M. MICHELL, the inventor of the "Michell-block," which has had a world-wide success, and has revolutionized practice in high-pressure bearings, has recently completed tests of a new type of steam engine. There have been many attempts to construct a crankless reciprocating steam engine, but none of these has achieved any great measure of success. In the latest type, however, advantage has been taken of the new principles upon which the Michell thrust-block is founded, with every appearance of practical success.

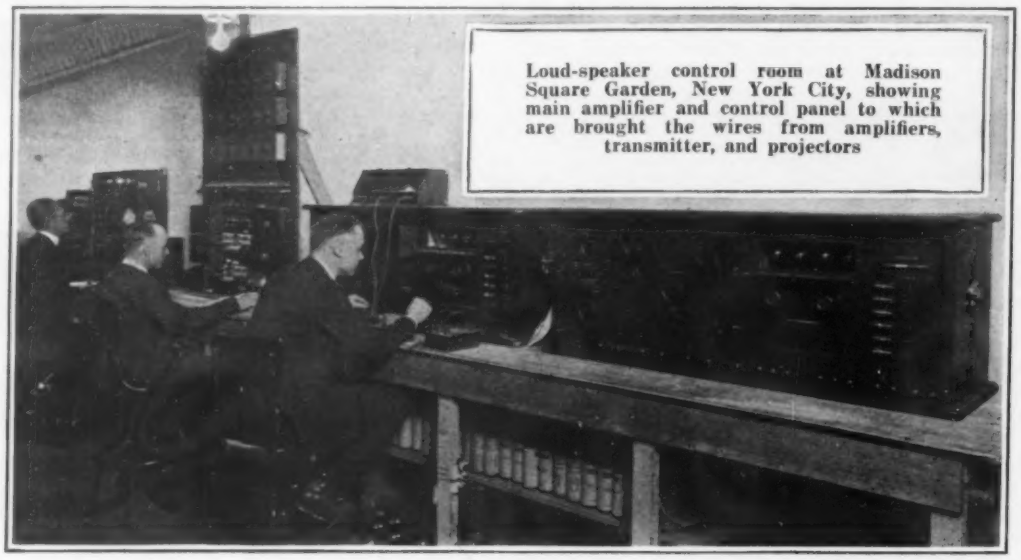
The engine is enclosed in a cylindrical casing, and the rotating shaft is co-axial with this casing. The cylinders are in two sets of four, arranged round the shaft with their axes parallel to it. Instead of crank-shafts there is a swash-plate, *i.e.*, a plate with its plane inclined to the shaft-axis; the angle of inclination of the swash-plate in the test engine is 62½ degrees, but in later engines this will be increased to 67½ degrees. As the shaft rotates it will be seen that the surface of the swash-plate will alternately approach and recede from each of the cylinders in turn. Pistons in the cylinders, bearing upon the plate through spherical bearings and Michell pads, are thereby given a reciprocating motion. Opposing pistons are connected rigidly by a bar crossing the outside of the swash-plate. The engine is uniflow, steam acting on one side of the pistons only. It is admitted to the cylinders by two rotating disk valves, one at each end of the casing, and exhausts at the end of the stroke. Very perfect balance is assured, and the designed speed of 1200 r.p.m. is largely exceeded. The cylinders are 5 inches in diameter, and the engine develops about 90 horsepower at 1200 revolutions. It may be mentioned that the coefficient of friction at the Michell pads, where the pistons bear on the swash-plate, is about 0.002. The whole engine owes its success to this very low value. It may be that an engine of this general design may ultimately be used for aircraft power plant, because of low weight.

The Voice With the Nation-Wide Audience

Electrical Equipment Employed in Conveying Arlington Ceremonies to Thousands in New York and San Francisco

By Robert W. King

PUBLIC use of loud-speakers has occurred on several occasions recently, notably at the inauguration of President Harding. However, the arrangement used on Armistice Day far exceeded any previous demonstration of the remarkable properties of this latest device for the transmission of speech. On Armistice Day President Harding's address and the prayers and the songs at Arlington were heard as clearly and with as much feeling by 30,000 persons in New York City and 20,000 in San Francisco as though each member of these audiences had been among the specially invited guests within the Arlington Amphitheater. In addition to this at least 100,000 persons scattered on the hillsides outside the Amphitheater also heard the entire ceremony with little difficulty. The combined audience of 150,000 is by far the largest which ever heard a speaker at one time, and the fact that the assemblage was partly on the Eastern Coast and partly on the Western makes the event even more remarkable.



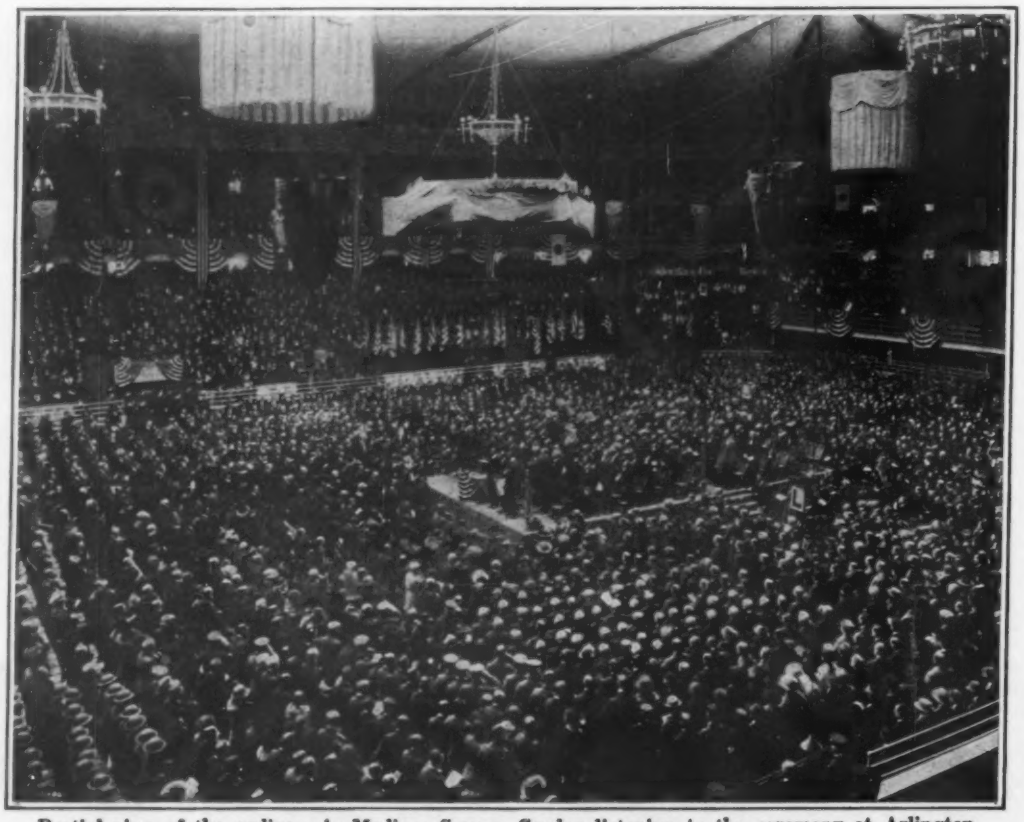
Loud-speaker control room at Madison Square Garden, New York City, showing main amplifier and control panel to which are brought the wires from amplifiers, transmitter, and projectors

So unheralded was the linking of the three cities in united service and so promising seem the potentialities of the device which achieved this end that the following information is presented not so much for its timeliness as for its bearing on the future.

The success of the equipment used on Armistice Day means, for example, that the President of the United States, if he so desires, without leaving his seat of government, may talk to audiences assembled in every State in the Union, or that the head of an industrial corporation from his office will be able to address, simultaneously, his workers gathered in plants all over the country; likewise college commencement exercises, political speeches, lectures, musical festivals—in fact, all forms of entertainment—can now be transmitted to any number of audiences of almost any size at one and the same time. The influence which this latest triumph of science will exert upon political and industrial activities will certainly be for the better, as it will do much to restore the personal element which ever-increasing numbers and distances have gradually eliminated.

The electrical equipment used on Armistice Day divides itself into two distinct sets of apparatus. First, the apparatus for increasing the volume of speech at Washington, New York and San Francisco; secondly, the apparatus for projecting it out to the large audiences, loud-speakers of the type developed by the Bell Telephone System being installed for the purpose. These loud-speakers were joined by a single telephone circuit which extended across the continent as shown in the accompanying schematic diagram. This circuit is likewise a development of the Bell System, and only recently has been perfected and installed.

Loud-speaking equipment, to be suitable for important public gatherings, must reproduce speech which is natural and lifelike in all respects. By far the most difficult problems which had to be solved in developing the present loud-speaker equipment were those involving the transmission and reproduction of speech with perfect fidelity, so that all the characteristic inflections and modulations of a speaker's voice, slight though these might be, would be accurately preserved. These problems proved much more difficult to solve than that simply of producing large amplification of the voice. They have, however, been met successfully and the present loud-speaker system is eminently satisfactory both as regards volume and articulation, and so marks a distinct advance in the art of speech transmission. So natural are the sounds of the voice as they come from the loud-speaker, and so very slight is the transition from within earshot of the speaker to the region where only the projectors are heard, that if a person who is standing beside the speaker should walk away, keeping his back turned toward the latter, he could go off 200 feet, or even more, and still have a very distinct impression that the speaker was just behind him.



Partial view of the audience in Madison Square Garden listening to the ceremony at Arlington many hundred miles away

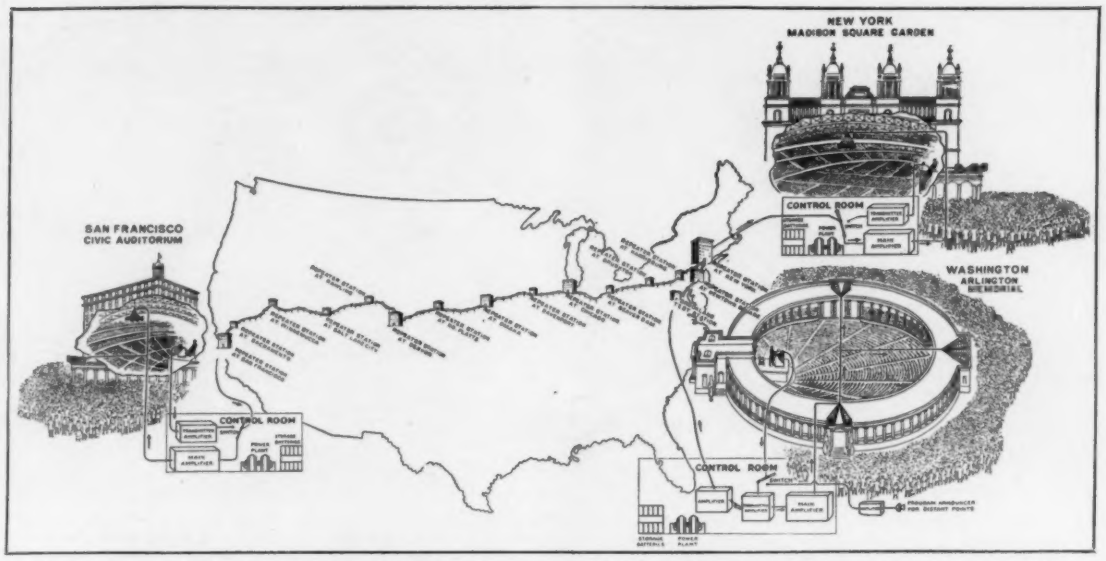
In many respects the principles underlying the operation of the loud-speaker and those underlying a long-distance telephone circuit (*e.g.*, the transcontinental circuit used on Armistice Day) are similar. Each usually comprises a transmitter containing loosely packed granules of carbon whose agitation by the air waves created by the voice gives rise to variations of the electric current flowing through them, these variations being an exact copy of these waves; a receiver of the electromagnetic type which converts the variations of the telephone current back into sound waves; and an amplifier for increasing the energy of the telephone current as it comes from the transmitter.

Now in flowing through a long circuit such as the transcontinental line, the telephone current grows steadily weaker as it gets farther from its starting point, and it soon becomes too weak to operate a telephone receiver satisfactorily. Long-distance telephony, therefore, demands some form of amplifier to restore the voice current to its original value. In circuits more than a few hundred miles long, the restoring or amplifying is, for practical reasons, done at regular intervals along the line. These amplifiers are known as telephone repeaters, and their locations in the transcontinental line are shown in the diagram.

The purpose of the loud-speaker is to magnify speech sounds and project them into the air so that they will reach very large audiences. In connection with the loud-speaker we employ amplifiers, not to restore an attenuated telephone current as it traverses a long circuit, but to magnify the original current as it comes from the transmitter to the order of thousands or even millions of times, and then to reconvert it into very intense sound waves by means of large and powerful receivers. The amplifier of the loud-speaker may receive the small telephone current which it is to magnify directly from a transmitter, as was the case at Arlington, or from a telephone line, as in New York and San Francisco. This point is clearly brought out in the diagram. Through the agency of its amplifier and powerful telephone receivers, the loud-speaker at Arlington gave to the words of President Harding and the other speakers some twenty thousand times as great a volume as that with which the speakers themselves uttered them. The intense sounds generated by the receivers were directed to each audience by clusters of large wooden horns or "projectors" shaped very much like megaphones.

The transmitter of the loud-speaker stands three or four feet in front of and below the person addressing the audience, and consequently receives but a very small fraction of the sound coming from his mouth. Because of this fact and certain others, the electrical amplification involved in the

loud-speaker must be truly enormous, requiring such numbers to express it as those with which astronomers delight to startle the imagination. Calculations show that the loud-speaker at Arlington was capable of stepping up the energy of the telephone current coming from its transmitter considerably over one billion fold. The extreme case of amplification, however, was that involved in reproducing the Arlington ceremony at San Francisco. This involved boosting the energy at fifteen repeater stations across the continent as well as initially at Arlington and finally in the loud-speaker at San Francisco. The total amplification within the transcontinental line was over one hundred million million fold. Combining this amplification of the line with that imparted to the telephone current before reaching the line in Arlington and after leaving it at San Francisco, gives the total amplification as about ten trillion trillion fold, or 10,000,000,000,000,000,000,000,000, if one prefers to see it written thus. And it should be borne in mind that this trillion trillion fold amplification was so accurately controlled and applied that the audience at San Francisco heard the speeches and songs as realistically as though they were standing but a few feet from the speaker's stand at Arlington.



Schematic layout of the Arlington installation for catching the voice waves of the speakers, the amplifying and repeating units, the circuit, and the arrangements at New York and San Francisco

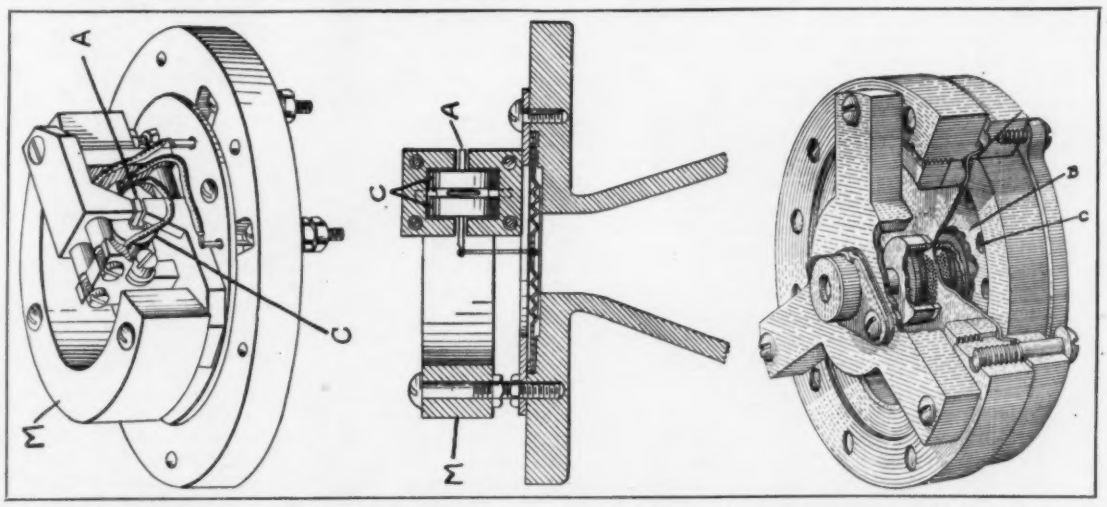
The amplifiers of both the loud-speaker and the telephone repeater make use of the three-electrode vacuum tube which is rapidly becoming one of the most important present-day items of electrical apparatus. A vacuum tube amplifier, it should be stated, is not a device which in any sense of the word creates energy. For all that modern science knows, the amount of energy in the universe can neither be increased nor diminished. Reduced to its simplest terms, the amplifier is simply an electric valve which is so extremely sensitive that by its means one electric current can control with absolute accuracy the flow of another current which may be as much as a million times larger.

To bring out this *control* action of the amplifier more clearly, consider the course of events in the transcontinental circuit as illustrated in our diagram. A small undulatory current is generated by the transmitter on the speaker's stand at Washington whenever sound waves strike it. This small current flows only as far as the first amplifier where it brings about the liberation of a much larger undulatory current from a battery associated with this amplifier. The variations of these two currents are identical in all respects except that of size. The new and larger current flows to the first repeater station at Newtown Square, in reaching which it has become much smaller than it was originally. At this repeater it liberates from a Newtown Square battery a third current—about as large as that which previously started from Arlington—which flows to New York, where the process is again repeated, and so on through the remainder of the fifteen repeater stations extending across the country. The final stage of amplification occurs in the amplifier of the San Francisco loud-speaker, in which the current coming from the telephone line causes the liberation of a relatively very large current from the power plant of the loud-speaker. This final current operates the battery of loud-speaking receivers directly. While a minute or more may be required to read about the progress of the telephone current across the country as thus set forth, in reality it occurred almost instantaneously, so that the audience in San Francisco actually heard each word sent from Arlington not more than 1/50 second after it had been uttered. To put this another way, it is known that in the improved type of transcontinental circuit the telephone currents travel across the country with practically the speed of light, so that a given event in Washington and its reproduction 3500 miles away are virtually simultaneous.

The Utilization of Atomic Forces

THAT the atoms, those smallest bricks of nature, of which chemistry teaches us all material is but a combination, are the seat of unbounded energy one may say has only been discovered by the appearance of radio activity. Thus, for instance, it is proved that a very tiny particle of bromide of radium suffices to raise and keep the temperature of its nearest surroundings by several degrees, continually throwing or into space a vast number of electrons, which are very tiny particles charged with electricity. This activity continues for about 5000 years till the whole of the salts of radium have been used up. If one takes this fact as a basis of calculation one finds that the energy contained in a single gram of radium would be sufficient to bring 10 million litres of water from zero degrees to the boiling point. Scientists are today of the opinion that radioactivity is not only a property of radium, uranium or thorium atoms, but that it is common to all atoms whatever, only that in other atoms this power is latent. If it were possible to start the decomposition of the atoms, which takes place in the case of radium by itself, artificially, the radioactivity must needs also appear.

The quantity of energy that could be won by such means is enormous and infinitely greater than that attained by chemical reaction or combustion. Up to the present we have produced energy from coal,. where the atoms of carbon remained unchanged only combining with the oxygen and forming carbonic acid. If it were possible to break up the atoms of the coals and cause them to spend their latent energy, an ocean liner of 50,000 horsepower could travel across the oceans uninterruptedly for ten years using all this time only a single kilogram of coal. Of course the interatomic energy at our disposal today is inadequate, but this does not say that it will always remain so. Perhaps there will come a time when we shall use the energy in the atoms to drive our machines, cook our food and heat our rooms. Besides already today we are actually using—even if only a very tiny part—the atomic energy. Thus, for instance, the rays emanating from radium are used for therapeutic purposes and the electrons emanating from a glowing filament can be directed so easily that they can be used in a large number of apparatus for wireless telegraphy and telephony. Most probably plants also make use of this energy in their growth because it has been demonstrated that the rays of the sun liberate electrons from the green leaves, and lastly it may also be mentioned that we humans also use a little of this interatomic energy when seeing with our eyes, which we are enabled to do by the photoelectric action of light.

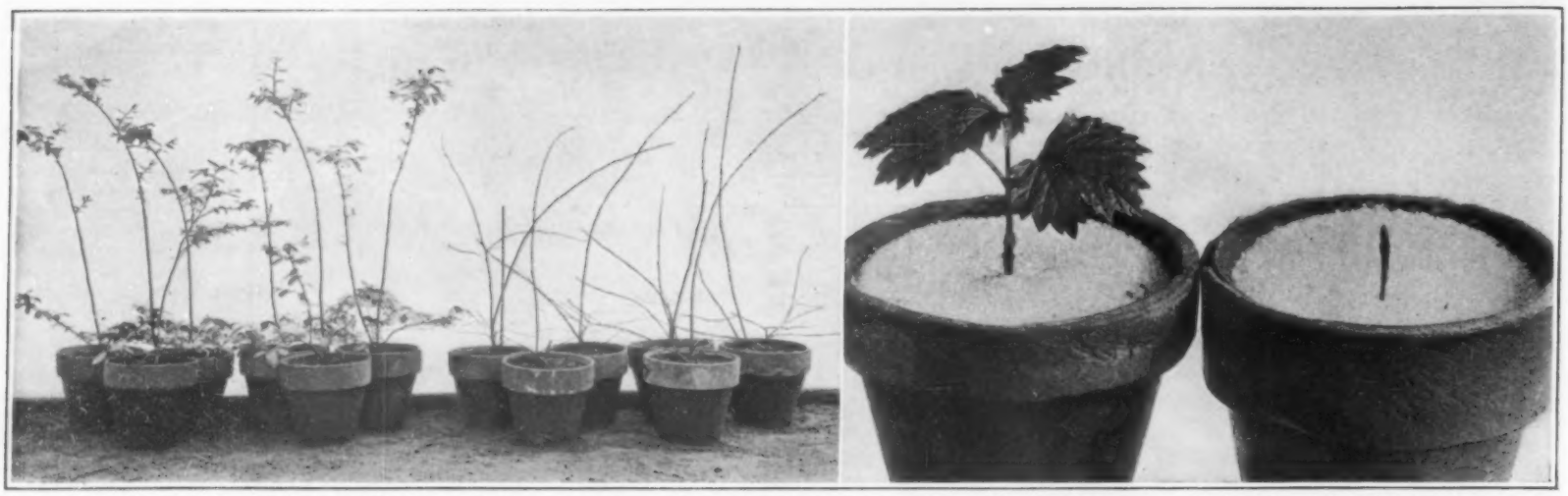


The first two diagrams are of the loud-speaking receiver. *M* is a permanent magnet, *A* is a soft iron armature pivoted at its center. *C* are coils of wire through which flows the telephone current which affects the magnetic properties of the armature. The pivoted armature is connected to a corrugated diaphragm, as shown in the second diagram. The third diagram shows the construction of the sensitive microphone or transmitter employed for catching the voice waves. There are two microphone units containing carbon granules, mounted on either side of the diaphragm which is indicated by the unlettered line. *B* is the face of the transmitter, perforated with holes *C*. The electrical connections are such that the distortion of speech which each button tends to introduce is exactly counteracted by the distortion of the other

Two ends of the loud-speaker installation: The loud-speaking receiver and the transmitter

A New European Light Electric Car

THE light motor cars that have been brought on the market hitherto are all fitted with combustion engines for liquid fuels. Now there appears a new one with electric propulsion that has many advantages. First of all, electricity is at present cheaper than fuel and then it is a fact that can not be gainsaid that the life of tires on an electrically driven car is three times longer than on any other. Also there is another advantage the electric car has, in that it is cheaper and simpler to keep up and to run. It is not necessary to start the motor by external means. The car starts by simply moving a lever at the driver's side. The radius of action of this car is so large that it is in every way suited for town and short distance traffic. It can attain a speed of 12 to 18 miles per hour and can surmount slopes of 15 per cent. The battery is in the front part of the car and is large enough, when it is charged fully, to take the car over 48 to 60 miles of even road. The car having been used during the day the accumulator can be recharged during the night from any continuous current main by using a suitable resistance, so that in the morning the car will again be ready for use. The accumulator can also be charged from a main with alternating current if a suitable rectifier be used. To recharge the accumulator it is only necessary to connect the pin plug on the switchboard of the car by cable to the charging arrangement. The high price of gasoline in Europe gives the electric car a very definite advantage at present.



Left: The six blueberry plants at the left of this group spent the winter outdoors and were brought into the greenhouse early in the spring; one month later they had developed as shown in the picture. The plants at the right spent the winter in the greenhouse, escaping the natural chilling; and these specimens were still completely dormant when the photograph was staged. *Right:* Two yearling seedlings of the grouseberry which had been similarly treated

Demonstrating the necessity for a period of winter chilling as a prerequisite to the spring growth of plants

How Jack Frost Stimulates Plant Growth

Novel Experiments Which Go to Show That Chilling Governs All Vegetable Growth

By D. H. Georgian

ACCORDING to common belief, cold weather causes plants to become dormant during the fall, while warm weather the succeeding spring again incites new growth. Intensive investigations of Dr. Frederick V. Coville of the Federal Department of Agriculture, which have been conducted over a period of ten years and which have covered every phase of this subject, demonstrate that both of these traditional theories are erroneous. Dormancy in our native trees and shrubs begins some time before the start of cold weather each winter; the appearance of Jack Frost is not necessary for the establishment of complete dormancy. Furthermore, after such a condition of dormancy has developed exposure of the plants to the ordinary growing temperature thereafter does not arouse them from their lethargy so that they begin growth anew.

Interestingly enough, the Coville experiments show that plants which have responded to the lure of autumnal and winter dormancy will not react properly and resume normal growth the following spring unless they are subjected during the interim to a period of chilling. A certain amount of cold is essential to stimulate the plant growth—despite the old-fashioned idea that retarded growth and low temperatures were synonymous. Dr. Coville removed healthy blueberry plants during the late summer from their outdoor beds and placed them in a greenhouse, where the plants were maintained at ordinary growing temperatures such as would have kept the plants in luxuriant growth during the spring and summer months. Despite these ideal environments the refractory blueberry plants refused to continue to grow, but instead shed their leaves and shortly lapsed into a condition of complete dormancy.

Subsequently these practical tests were repeated again and again with many different kinds of plants, and without exception all trees or shrubs which were natives of northern, cold climates fell asleep in the late fall and early winter irrespective of the temperature. Comparative studies of the susceptibility of indoor and outdoor specimens of the same families of plants indicated that dormancy develops a little more quickly in the plants exposed outside, evidently because their foliage is injured by freezing weather and because they drop their leaves earlier than do the indoor plants. In fact, unnatural warmth is a detriment to plant growth, inasmuch as trees and shrubs that are kept continuously warm during the winter take up their ordinary growth much later the following spring than their mates which are exposed to a period of chilling and freezing weather.

Doctor Coville's detailed tests show that the indoor plants which are not exposed annually to an era of cold weather thereafter will not bloom. On the other hand, plants which spent the cold-weather period outdoors burst into leaf and flowered luxuriantly in the spring when they were subjected to proper growing conditions. In the early stages of his investigations this scientist assumed that the plants had to be frozen to stimulate them to growth, but later on more detailed research showed him that the plants required only exposure to prolonged chilling for a period of two or three months at a temperature reasonably close to zero. Where this chilling does not occur plants will remain dormant for periods as long as one year under circumstances where the heat, light and moisture environments are ideal for expeditious and robust growth.

The stimulating effect of cold is limited to such portions of the plant as are subjected to chilling. For example, a single blueberry plant 44 inches high which had shed its leaves and become dormant in a warm greenhouse where the average temperature was about 65 degrees, was repotted and placed in a position of southern exposure. A small opening was made in the glass of the greenhouse through which one or two of the stems of the plant were projected. The opening around the stem was then carefully plugged up with moss. Henceforward, throughout the winter, part of the plant was exposed to winter weather outside the greenhouse, while the remainder was carefully sheltered and kept warm within the plant residence. The following spring the outdoor branch grew rapidly and luxuriantly while the indoor branch continued dormant. Another test of this description was carried out, in this instance the plant being placed on a shelf outside the greenhouse and a single branch passed through the glass wall into the warm interior. When the warm weather of spring arrived the branch of the plant inside the greenhouse still remained dormant while the outside branches began to grow.

On one occasion Dr. Coville made 286 cuttings from dormant outdoor blueberry plants, which he stored in bundles, some in moist moss, others in birch sawdust at a temperature of about one or two degrees below freezing. He allowed these cuttings to remain in cold storage for nine months and at the end of that time, except in the case of several cuttings which mildewed and died, one or more buds had begun to swell on every cutting. This indicates that growth had begun to occur even at this low cold storage temperature. On another occasion he placed 58 cuttings from dormant outdoor blueberry plants in moist birch sawdust at a commercial cold storage temperature of about 34 degrees. Nine months later buds on every cutting had begun to grow. None of the cuttings gave a starch reaction, indicating that their transformation of stored starch into sugar was completed despite their subjection to freezing exposures.

According to Doctor Coville, the establishment of a dormant condition before the advent of freezing weather and the continuation of this dormancy through warm periods in late fall and early winter are protective armors adapted for the use of the native plants and shrubs. The principle of chilling is of the utmost importance to plant growth. If plants were constituted so that they would start growth readily in the fall under the influence of a few warm days—without the need of several months of chilling—as they do in the spring, many of our plants would begin to grow and burst into bud under the influence of the warm weather of Indian summer and subsequently would be killed by the first heavy freeze. But our native trees and shrubs are so intimately adjusted to the changes of climate to which they have been long exposed that they are almost completely protected from injury by freezing. On the other hand, cultivated species of plants introduced from sections of the world having a climate radically different from ours are only imperfectly adapted to our climatic changes. These foreign plants attempt to grow at times when our native plants have "learned" that it is desirable to remain dormant, with the result that the majority of such venturesome trees and shrubs are killed.

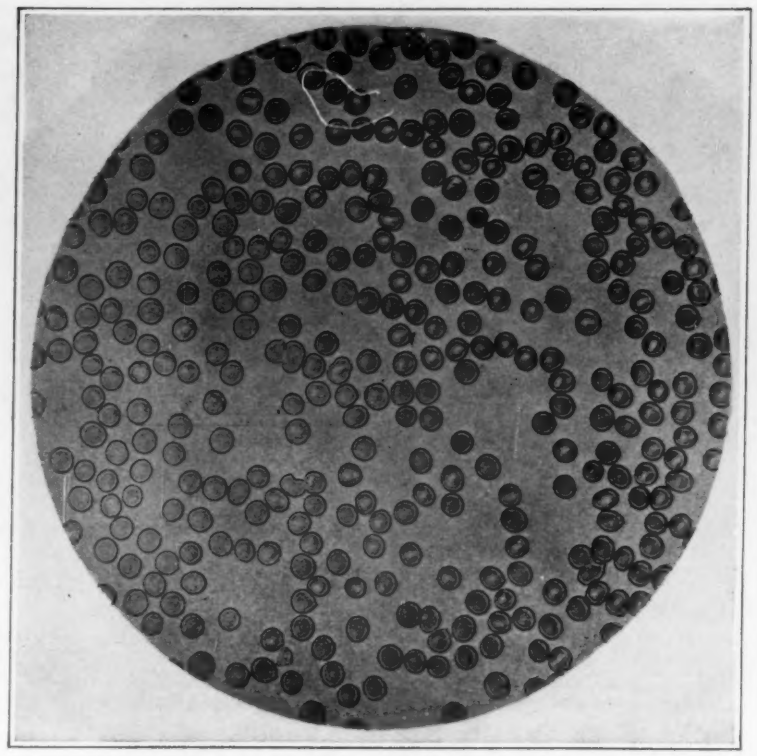
To test out all this, one may during mid-autumn bring into the house and place in water freshly cut, dormant and leafless branches of a few early spring blooming plants such as the alder, hazelnut, pussy-willow, yellow bush jasmine, Japanese quince, peach or plum. They will not bloom. Repeat the performance during mid-winter and the branches cut at the later dates will bloom. The period of winter at which these plants will respond in this way depends on the time which they, respectively, require for their annual chilling. Thus the period of chilling for the peach in Georgia is so short that sometimes unusually warm weather in December will bring the trees into flower, only to have the fruit destroyed by the winter freezes which always follow. But no one ever heard of winter-killed violets; their chilling period is winter-long.

Chilling is a necessary event in the annual cycle of the cold-winter trees and shrubs. It is so essential that it limits the geographical distribution of such varieties of plant life. The common northern fruit trees such as apples, pears, peaches and cherries when introduced to tropical countries grow well for a while but ultimately develop dormancy and finally die because they are divorced from the customary chilling for several months a year to which they have long been accustomed. To produce fruit of this description under tropical conditions necessitates the artificial chilling of the plants at stated intervals. Uncle Sam has actually tested out various laboratory contrivances to be used in this artificial chilling.

Doctor Coville suggests that the field of investigation concerning the chilling of plants is still fertile for more comprehensive investigations as he feels that his studies have only lifted the lid which heretofore has concealed scientific facts of immeasurable importance. He believes that scientific research should now be directed toward such practical goals as the determination of the proper temperatures for the storage of seeds, bulbs, cuttings and grafting wood; the proper temperatures for the treatment of plants which are to be forced from dormancy to growth at unusual seasons; and proper temperatures for the storage of nursery stock so that the nurserymen may have the plants in proper condition for shipment on any dates satisfactory to the purchasers.

Photographing Blood Stains

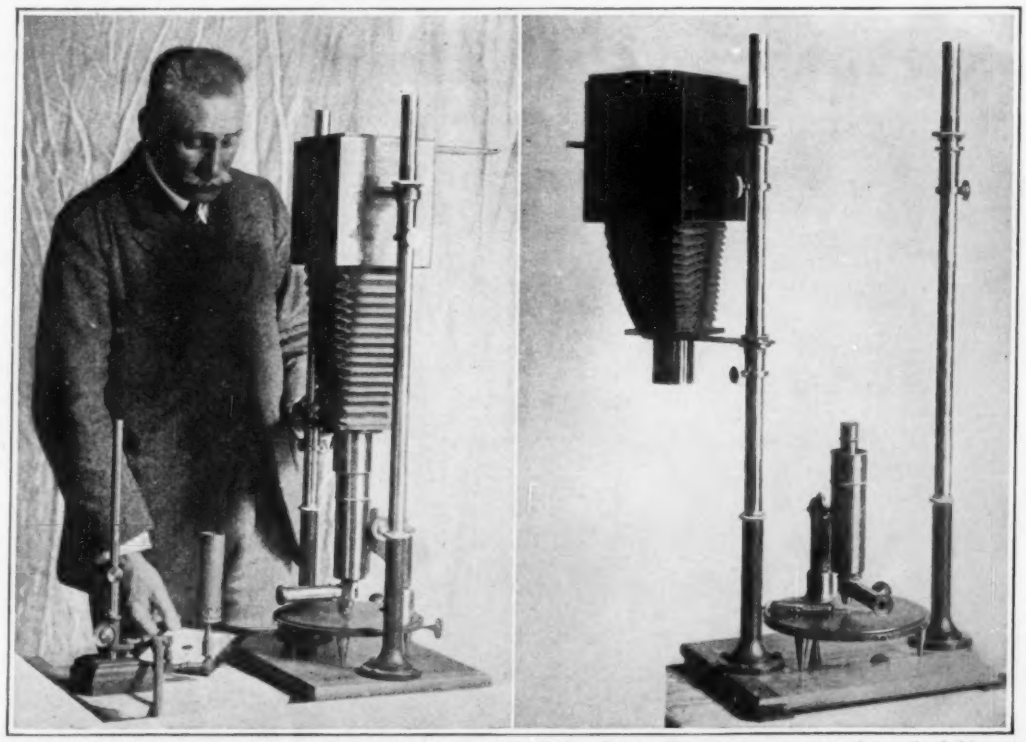
MODERN criminology involves a very close study of bloodstains; and the expert to whom the court assigns this more or less gruesome job has not an easy task. In the first place, it often happens that there is not much blood left on a weapon. If it be a dagger or other sharp instrument much of the blood may have been wiped off on the edges of the wound or on the clothing of the victim. In many cases the stain is so faint and indistinct that it is very difficult to get the proper chemical reaction in the process which is usually employed in the close examination of such clues. This new apparatus, of which we show two views, obviates the necessity for the crystallization of the tiny blood globules. The fainter the stains are the better; for those very stains which are the faintest, because of their widely separated globules, are the most desirable for research work. The camera is the invention of Dr. Florence, a professor at the School of Medicine at Lyons; and it is manufactured by Nachet, of Paris. It merely attempts to record the photograph, or photomicrograph, of the stain, without changing it in any way. And such a photograph, of the stain itself, left untouched so that it may be photographed again if necessary, is a far more convincing proof to present to the court than are a few tiny crystals, for example, which are only the products of chemical treatment. Another advantage of this microscopic examination is to show, by the form and size of the globules, whether it is the blood of a human or an animal. One of our illustrations is a photomicrograph showing the globules in a drop of human blood, greatly magnified.



The normal appearance of human blood under the microscope

This photomicrograph apparatus of Dr. Florence is comparatively simple in construction. It is made up of three parts: the microscope itself, an incandescent gas lamp, and a camera. The whole apparatus stands on a wooden base, from which rise two metal columns. Each of these columns consists of two tubes, one sliding within the other; and they may be raised or lowered by loosening the tension of the screws. On one of the columns is swung the camera, a black box for holding plates 9 by 12 inches, provided with a bellows which may also be raised or lowered. This camera may be pushed to one side while the object is being studied under the microscope, and then swung into position and fitted over the microscope when the observer is ready to make his photographic record. Between the two columns on the wooden base stands a powerful microscope. The weapon to be examined is placed on a flat platform directly beneath the magnifying lens. To one side is an incandescent gas lamp, fastened to a movable arm, so that it can be placed in the most favorable position. When placed on the base, in front of the microscope, its rays cross the horizontal tube of the apparatus, and by a system of prisms inside are thrown directly on the object. After a close study of the object, the camera is swung into position, and both the box and bellows are raised or lowered to any distance from the object so that it may be magnified and photographed at the desired size.

By this method Dr. Florence and other scientists have photographed bloodstains on colored materials. Under such circumstances, the stains are often scarcely visible. The material is treated with an application of a liquid which discolors the fabric itself, but brightens the color of the blood. When viewed under the microscope, even the tiniest trace of blood is sometimes sufficient to be a very important clue in establishing the truth about a crime.—*By C. M. Lewis.*



Left: Making a photomicrograph of a drop of blood from a knife-blade. *Right:* The Florence apparatus for work of this sort

Photomicrographic examination of blood stains, an achievement of modern criminology

Magnetized Scale Weights

RECENTLY erratic and unsatisfactory scale weights designed for use on analytical scales in research laboratories have been submitted to Doctor Pinkowsky of the Federal Bureau of Standards for examination and correction. The scales on which these weights were used were useless so far as accurate and authentic weighing was concerned, and the scientists using these scales were exercised and anxious to run to earth the cause of error. Doctor Pinkowsky found out that the inefficiency and inaccuracy of the scales were due to the delicate weights used which were made of magnetic material. In this connection he wishes to warn all scientists and technical experts who have to purchase or use analytic scales and minutely small weights of this description to make certain that such weights are made of non-magnetic material.

The satisfactory weights for use on analytical scales which aggregate one-half a gram or less in weight are made of platinum or gold. Such weights are not subject to magnetization. On the other hand, delicate weights of this type made of steel, iron, nickel, nickel alloys or other magnetic materials are liable to be so magnetic as to be practically useless for accurate employment in scientific and research laboratories where foreign factors which exert erroneous influences are undesirable. Once delicate weights of this sort are magnetized, it is practically impossible to demagnetize them so that subsequently they may be used commercially. Doctor Pinkowsky advises that all scientists or technicians who purpose to purchase scale weights for use on delicate laboratory scales should test out the magnetic properties of these weights before making the purchase in order to insure against buying weights made of magnetic materials which would be worthless for work where the slightest error would be of important concern in governing the success of the results.

Cocoa and Cacao

THERE is still considerable confusion in the minds of a good many general readers in the north as to whether fruit cocoa and the breakfast cocoa are products of the same tree. In the German, Spanish and French languages the correct spelling of the breakfast beverage, *cacao*, has been preserved as it should have been in the English language. This confusion arose in England and America, because the a's in the correct name *cacao* have been changed to o's and the final o changed to an a.

Cocoanuts are produced by the cocoanut palm, or *Cocos nucifera*, growing throughout the tropical parts of the world. It has no branches, properly so called, but the leaves 12 to 14 feet form a kind of crown or fan-like summit to the tree, beneath which grows a cluster of the fruit or cocoanuts, which are collected and shipped to northern markets, where they are called cocoanuts.

The tree has very many uses. The roots are chewed; gutters and posts are made of the trunks; the young buds are prepared and eaten in the same way as cabbage; the leaves are manufactured into baskets, mattings and many other articles. The midribs of the leaves form oars, and the bruised ends may be used in place of brushes; the juice of the stem yields palm wine, while the sap produces a sugar. If this sugar is mixed with lime it forms a powerful cement. The white meaty part inside the shell of the cocoanut forms a wholesome food and the milk a cooling drink. The coir or fibrous covering of the hard shell is used for cordage; the shell is used as a drinking cup, and the white meat inside yields the well-known cocoanut oil of commerce. All these uses and many others are attributed to the cocoanut palm, but it does not give us the breakfast cocoa.

It is the *Theobroma cacao* that yields the cocoa or cacao, as we shall call it. The tree is a native of South America, but it has been planted also very extensively in all parts of the tropics. The Mexicans call it chocolate, which is one of the names we use. The cacao tree is an evergreen and bears fruit and flowers all the year round, but the usual times for gathering the fruit are June and December. The seeds in the fruit possess the properties which we recognize in cocoa and chocolate as a valuable article of food. The amount of these seeds imported annually now exceeds 150,000,000 pounds.

1. Cooling photographic solutions; hypo packed in a large tray cools the solution in the smaller one. 2. Cooling a bottle of milk with hypo. 3. Hot water bottles filled with the hypo are preferable to the ordinary ice-pack. 4. This device, with hypo in the can under the conical hood, cools the water as it flows from the faucet. 5. Fruit closets and cupboards may be cooled by allowing the incoming air to pass over an open tray of the cold hypo

Some of the places where the cooling action of ordinary photographer's hypo may be utilized

A New Use for Our Old Friend Hypo

By Frank B. Howe

THE use of common "hypo" (sodium thisulphate) as a cooling medium, in place of ice or any of the expensive chemical cooling processes, is the innovation of a California chemist who recently disclosed the surprisingly simple and costless process he has devised.

It is common knowledge to photographers that hypo, when dissolved in water, causes the temperature of the solution to become very low. Starting with this natural property of the cheap chemical, the inventor has adapted this quality to practical use and so harnessed the hypo that it may be substituted for ice for use in the kitchen, in hospitals, in the photographic laboratory, in house ventilation systems, and so on indefinitely through the whole list of places where lowering of temperatures is desired.

For cooling milk and other kitchen commodities the bottle of milk is placed in an ordinary kettle; hypo packed around it in the same manner as an ice cream freezer is packed; and the hypo dampened with water. The temperature immediately becomes very low and remains so for several hours.

For hospital use the wet hypo is packed in ordinary hot water bottles. Where ice would quickly melt the hypo keeps cool for hours.

Similarly, the hypo method of cooling is used to cool off houses by passing the incoming air over a pan of wet hypo. For cooling drinking water as it comes from the tap, a glass jar of wet hypo, fitted with a conical top, is suspended below the faucet. The water passing over this becomes cold in the same way as water passing over ice would do.

The use of hypo in this way in no way affects its later use in the usual ways for photography and other purposes. Hypo costs around five cents a pound; hence this method would be cheaper than ice cooling, were the hypo thrown away. However, it can either be subsequently used for photography, or else it can be evaporated and used again and again for cooling. In either case, it is not only much cheaper than ice, but a great deal more convenient to handle.

Thus far the possibilities of this medium in the cooling line have been barely touched. There seems to be no limit to its possibilities and possible adaptations. It is simply a matter of taking advantage of the natural property of this chemical and utilizing a medium of cooling that nature has supplied gratis.

Work is now under way upon mechanical apparatus which will permit the use of hypo in great quantities for wholesale and commercial uses of lowering temperature. In such cases the advantage over ice would be very great. Likewise in eliminating a great deal of the cost of chemical cooling, as now known, the humble hypo is a great improvement and advantage.

However, hypo has its limitations. It will not produce a great drop in temperature, such as is required for many purposes, but it is suitable for many household duties.

Natural and Artificial Sweeteners

AT a recent meeting of the German "Bunsen" Society Professor Theodor Paul, the director of the "German Experiment Station for Foodstuffs," at Munich, gave an interesting address concerning the artificial sweeteners, saccharin and dulcin. Both these substances have the curious property of exhibiting a relative loss in proportion as the degree of concentration increases. In other words, a double amount added to an article of food or drink does not double the degree of sweetness in the latter. Prof. Paul discovered, however, that when combined with sugar either saccharin or dulcin increases the sweetening power in direct proportion, a fact which is all the more remarkable since these compounds have a very different chemical composition from that of sugar. It is also true that the degree of sweetness of an aqueous solution containing *both* saccharin and dulcin is approximately equal to the sum of the sweetening power of each constituent. For example, the degree of sweetness of a solution of 280 mg. of saccharin in 1 liter of water is so greatly increased by the addition of only 120 mg. of dulcin that the solution tastes as sweet as if it contained 535 mg. of saccharin. Here, in fact, the degree of sweetness is almost doubled, so that a saving of about 33 per cent is effected. This surprising result is explained as follows by a writer in *Die Umschau* (Frankfurt) for October 8, 1921:

"Saccharin and dulcin taste much sweeter, comparatively speaking, in low degrees of concentration than in strongly concentrated solutions. On the other hand, the sweetening power of the two is capable of 'addition.' Consequently it is possible by combining the two substances to take advantage of their incomparably higher sweetening power in more dilute solutions. The sweetening power of 280 mg. of saccharin in 1 liter of water corresponds to a 7 per cent solution of sugar; while 120 mg. of dulcin corresponds to 3 per cent sugar solution. Hence when the two are added together they have a combined sweetening power equal to a 10 per cent sugar solution, whereas to attain this same degree separately would require either 535 mg. of saccharin or 1430 mg. of dulcin. Professor Paul calls this mixture of substances 'the pairing of sweeteners.'"

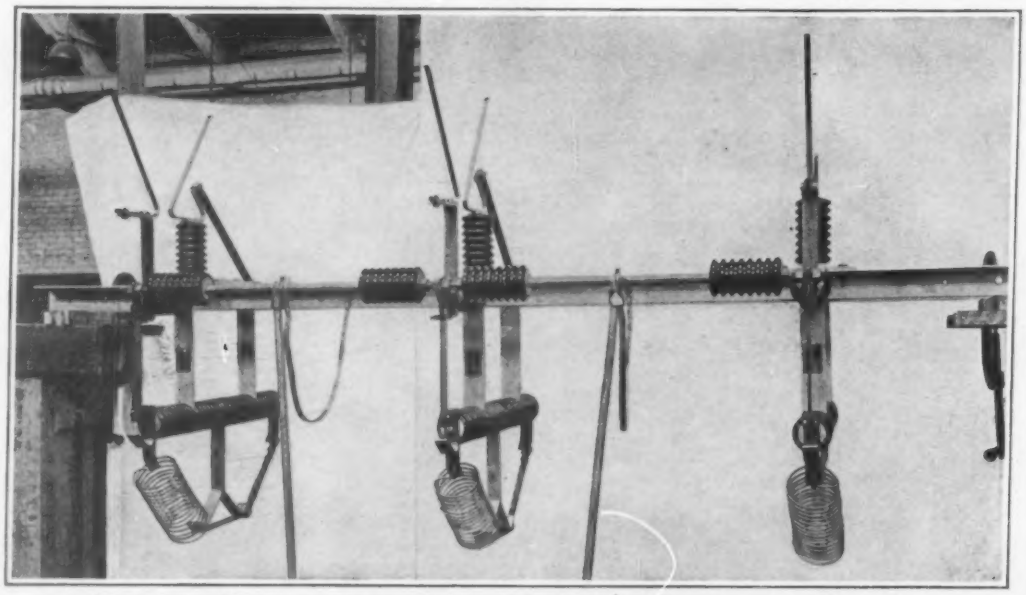
Some amusing tests were made at this meeting of the ability of the distinguished chemists present to detect the nature of the sweetening substance employed. They were offered cups of tea sweetened with one or the other of the three substances, but designated only by numbers. Twenty-one out of 34 persons who tasted tea sweetened with sugar were quite sure that an artificial sweetener had been used. In another test the guests were invited to sip alternately from cups of tea sweetened with sugar and with the combination of saccharin and dulcin, but without knowing which was which. In this case 15 out of 16 persons affirmed that the beverage containing the artificial sweeteners was the most palatable. This experiment was repeated with water instead of tea, and in this instance 23 out of 32 persons declared in favor of the artificial sweeteners without knowing which was which. These results caused considerable merriment, since many of the eminent chemists had previously declared themselves quite capable of distinguishing between the taste of sugar and that of artificial substitutes.

Safety in Farm Power Service

By Allen P. Child

THE increasing demand for electric power on the farm is responsible for the new protective unit recently introduced by a Chicago manufacturer of electrical equipment.

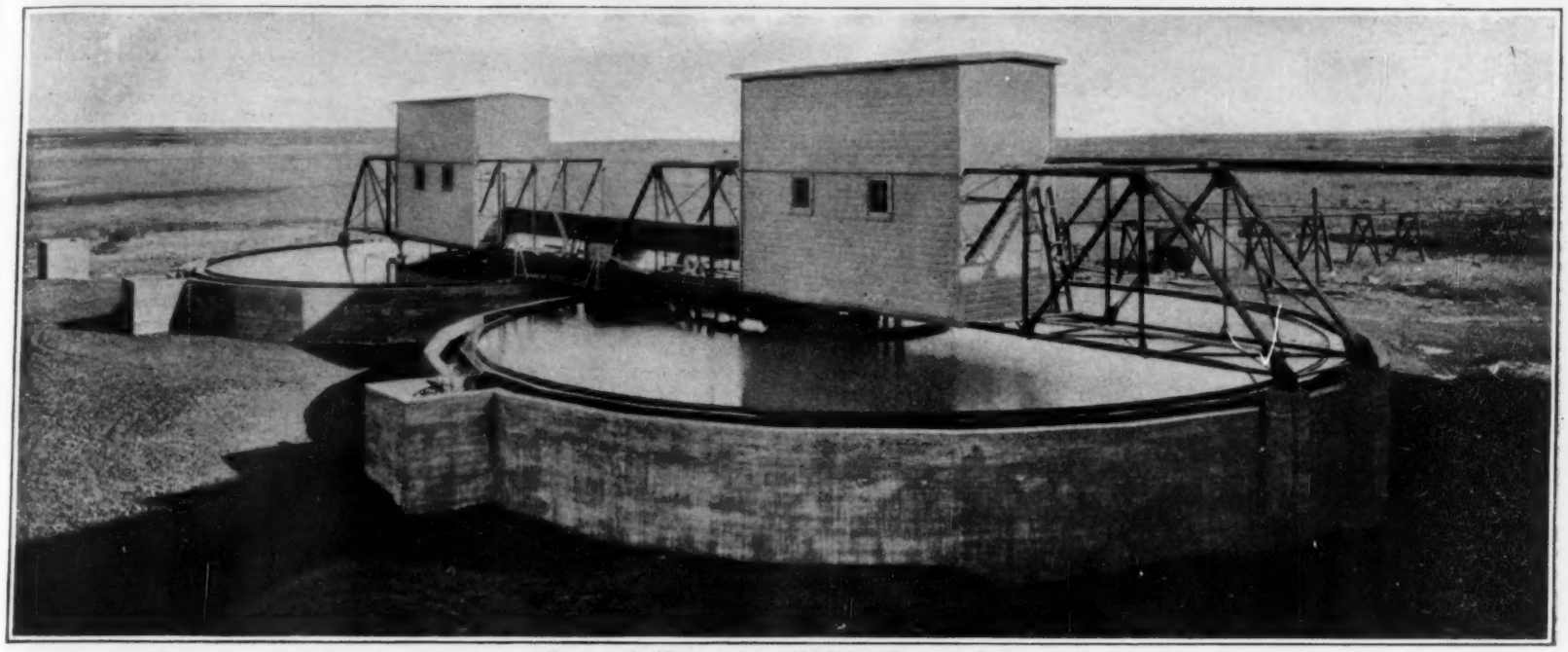
In reality this new unit is a miniature outdoor substation which makes distribution of power to isolated users simple and profitable. This switching and protective combination is furnished for service up to and including 25,000 volts and consists of an adjustable horn gap arrester, disconnecting switch, choke coil and fuse mounting, grouped in one unit.



Three-pole protective unit mounted on a galvanized angle-iron support, with rods for operating the switches from the ground

Units rated at 7500 volts are mounted on one cross-arm, while those rated at 15,000 and 25,000 volts are mounted on two cross-arms. No special structure is necessary as the equipment is light, self-supporting and requires no particular skill for installation.

Corrugated insulators for outdoor installation are one of the novel features of this combination. The corrugations of the insulators supporting the live parts are in all cases vertical. The corrugations of the insulator supporting the grounded arrester horn and resistance are horizontal. The parts supported by this insulator are normally grounded so that this arrangement is possible.



Sewage clarifiers to treat 120,000 gallons per hour

Sewage: The Price of Civilization

One of the Problems of Modern Community Life with Which Our Remote Ancestors Had No Concern

By Harry A. Mount

A DECADE ago nearly all American cities simply emptied their sewage into the most convenient body of water. But in ten years populations have grown more dense, the use of sanitary appliances producing sewage has increased many times and there has developed a strong public sentiment against disposal of this waste in an unsanitary or obnoxious manner. What to do with sewage, therefore, has come to be a municipal problem of first-rate importance.

In Europe, where dense populations have made this problem a pertinent one for centuries, only slight progress in the solution had been made, especially in England and Germany, but this experience has been the basis for American experiments. In the past ten years American sanitary engineers have not only kept pace with progress abroad, but have far surpassed foreign developments. Recent experiments would seem to indicate, indeed, that it is not only now possible to remove from the sewage the matter in suspension and solution in a cheap and inoffensive manner, but also the valuable materials known to be present can be salvaged in the form of a valuable commercial product.

Perhaps the first effective method of treatment, which is still in common use, is simply to flow the sewage into large basins, where the solid matter in suspension is allowed to settle and the remaining effluent is drawn off. At intervals the basin is drained and the settled sludge is dug out and carried away. But this method takes no account of the suspended particles too fine for sedimentation and the great amount of material in solution, and therefore can not be used by communities not near large rivers or other bodies of water.

There are in use at the present time no less than nine methods of sewage disposal, including:

1. Sedimentation.
   a. Straight sedimentation with sludge removal.
   b. Imhoff tank sedimentation, with self-contained sludge digestion.
   c. Septic tank sedimentation, with self-contained sludge digestion.
2. Removal of the coarse solids by the use of a mechanically-operated fine screen.
3. Chemical precipitation (followed by sedimentation).
4. Sand filtration.
5. "Sprinkler" or "trickling" aerating filters.
6. Contact beds.
7. Chlorination.
8. Electrolytic oxidation.
9. Activated sludge.

Three of these methods (five, six and seven) are seldom used as complete processes, but usually in combination with one of the others. Electrolytic oxidation perhaps should be regarded as experimental, as it is used only in one small plant. Of the remaining methods two stand out as most promising—Imhoff tank digestion and the activated sludge process. Both depend for their effectiveness upon the action of certain bacteria. Of these the activated sludge process is newer and has been given much attention recently. A long series of experiments has finally resulted in a solution to the most perplexing problem in connection with the activated sludge process, that of what to do with the sludge. The chief advantage of the Imhoff tank method is cheaper operating cost, but it is the prediction of some engineers that this advantage can be overcome. In such an event there is no doubt that the newer method would very nearly approach an ideal.

In the Imhoff tank method the suspended solids are allowed to settle in deep tanks, through which the sewage flows continuously. The tank has a sloping bottom so arranged that the sludge passes through slots into a separate sludge chamber. Here the ordinary bacteria of putrefaction become active and a digestive action takes place which very greatly reduces the sludge in volume.

Primitive sewage disposal in India; a woman standing waist deep in the sludge fills the bucket elevator

This method is open to the criticism that objectionable odors are generated, making it necessary to have the plant in an isolated spot, the expense of installation is very high, and the method takes no account either of the finer solids which will not settle or the material in solution. However, where large bodies of water are available so that a high degree of dilution can be obtained, it is usual to treat the effluent with chlorine to sterilize it and to empty it in this condition. Due to the fact that the bacterial action removes oxygen from the effluent, it may be poisonous to fish and other animal life unless greatly diluted.

It is usually necessary, therefore, especially in inland cities, to combine with the Imhoff tanks some other method to purify the effluent further before it reaches the streams. Three methods are in common use—contact filters, sand filtration, and aeration by sprinkling over large and carefully prepared filter beds. Especially the latter method is effective in producing finally a pure effluent, but in any case a large tract of land is needed in an isolated spot and the installation is expensive. But in spite of these drawbacks the Imhoff tank method is perhaps more widely used than any other in this country.

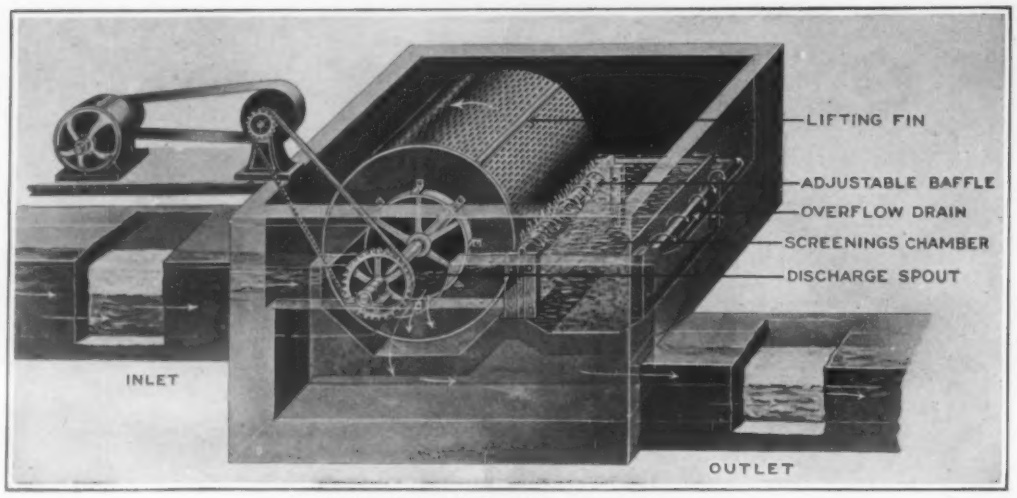
A partial explanation lies no doubt in the fact that such public improvements are usually paid for by bonding the community. The original size of the bond issue makes little difference to the politician—it is as easy to issue bonds for a million dollars as a hundred thousand. But the matter of operating expense comes under the head of current expense, and if heavy may make excellent election ammunition. Therefore an expensive plant which shows a low operating cost is preferred to a cheap plant with a higher operating cost, even though the latter may be ultimately the least costly system. Thus the sanitary engineer is often called upon to meet a political situation as well as a problem in sanitation.

The activated sludge process also depends upon a species of bacteria, but operates in an almost opposite manner. Instead of working in an inclosed sludge compartment, this species of bacteria is active only in the presence of air and light, and instead of merely causing the sludge to decay they consume it entirely. The tiny bodies of the bacteria finally settle to the bottom of the tanks in a brownish jelly-like mass and the effluent flows off clear and pure, of a quality almost equal to that of potable water. While the water is purified in a single step, the brownish sludge which remains has for some years presented a problem which seemed wellnigh unsolvable.

An activated sludge plant consists essentially of machinery for aerating the sewage as it enters the plant

by blowing air bubbles through it, tanks through which the sewage slowly circulates in contact with minute air bubbles for about four hours, and finally some system for removing and denaturing the sludge.

There is first developed, under laboratory conditions, a species of bacteria which is introduced into the sewage. In order to give the bacteria sufficient oxygen, compressed air is forced through the sewage and then it slowly circulates through the long tanks. At the end of about four hours the bacteria have entirely consumed the organic matter in the sewage and their bodies settle to the bottom. The water flows from the end of the tanks. As fresh sewage enters there is added to it a small quantity of the activated sludge to introduce a supply of bacteria. Thus, once started, the bacteriological process is continuous and automatic.



Mechanical self-cleaning sewage screen

The chief expense is that of operating the air compressor, as a very great quantity of compressed air is required. Two schemes are being tried to reduce this cost; first, the invention of means to keep the air bubbles in contact with the sewage for a longer time so as to increase their efficiency, and, second, partial separation of the sludge by sedimentation or screening before introducing into the activation tanks.

The most difficult problem in connection with the process, however, has been to find a means of disposing of the jelly-like sludge which is a by-product. It has been known that the sludge contains the ingredients of a fair grade of fertilizer, being rich in nitrogen in the form of ammoniates. But before the sludge is useful commercially it must be dried and mixed with other fertilizer ingredients. Various types of filter presses have been tried for drying sludge with indifferent success, for the physical nature of the sludge makes it almost impossible to reduce the moisture content sufficiently so that it can be handled by ordinary dryers. Centrifugal separators also have been tried, but it has been found that the microscopic organisms which form the sludge are so near the specific gravity of water that they will not separate. Air drying is impossible because the sludge, when allowed to stand, rapidly decomposes. It has been the practice in some plants to pump the sludge into an impounding reservoir, from which it is emptied into a stream at high water.

The chemical engineer has come to the rescue in this difficulty, and recent tests made by the city of Houston, Texas, have shown conclusively that it is possible to dehydrate the sludge economically and to recover in the process a fertilizer in large quantities. The method tried at Houston was designed by Angus Maclachlan of New York and operated essentially as follows:

A powerful sterilizing agent is introduced into the sludge as it is pumped from the settling tanks. The agent used is sulfur dioxide gas produced by burning yellow sulfur in a rotary burner. The gas is mixed with live steam in a specially designed mixing device and the gas-steam mixture is passed directly into the sludge tank by means of an inlet pipe in the bottom. Bacterial life in the sludge is at once destroyed, and in addition the gas has an electrolytic effect which causes the particles in suspension to coagulate. The mass is transformed in a very short time from its jelly-like consistency to a brownish granular mass which can be very easily pressed to a water content of about 75 per cent. It can then be dried by the sun or a mechanical dryer to a moisture content of 10 per cent, desirable for shipping. The material is then ground and is available for fertilizer manufacture.

Another method of dehydration tried successfully on a small scale but not yet applied commercially consists of mixing a small quantity of sulfuric acid with the sludge and then heating it. This has the effect of breaking down the jelly-like consistency of the sludge and causing the solids to float. The sludge is then easily skimmed off the top and dried in the regular manner.

It is the hope of the inventors of such methods that the sale of fertilizer which is salvaged will make the net cost of the activated sludge process compare favorably with that of other methods. If this end is achieved this process will have the advantage of a low cost of installation, of complete purification of the effluent, of a plant which requires a small space and which generates no offensive odors in operation, and finally of salvaging the useful material from the sewage.

The largest activated sludge plants now in operation in this country are at Houston, Texas. There are two plants, a north side plant, consisting of four units, each with a daily capacity of 2,500,000 gallons, and a south side plant, with two units of the same capacity. Each unit is composed of a main aerating channel 280 feet long, 18 feet wide, and 9.75 feet deep; ten sedimentation tanks 22 feet deep with a surface area of about 183 square feet each, and a sludge reaeration channel 280 feet long, 9 feet wide and 9.75 feet deep. Air is furnished by pressure blowers at 5.25 pounds per square inch, each blower having a capacity of 3200 cubic feet per minute. At the north side plant there are three blowers and at the south side plant two. The air is diffused through filtros plates and a total of about 1.44 cubic feet of air per gallon of sewage is used. The cost of operating the north side plant, with an average flow of 6,250,000 gallons per day, per million gallons is: Attendance $4.15, miscellaneous $0.85, power at rate of 6-10c per kilowatt hour $5.40, or a total of $10.40, interest and depreciation not included. At the north side plant a dehydration plant is now being erected at a cost of about $80,000, in connection with which the new sulfur dioxide process of dehydration will be used. The cost of this plant was about $225,000 and that of the south side plant $115,000. It is roughly estimated by a competent engineer that an Imhoff tank plant of the combined capacity of these two plants would cost about $3,000,000. The Houston plants are considered models in economy and efficiency.

Engineers are watching with intense interest for the results which will be obtained in two cities which are applying the activated sludge process on an even grander scale. At Milwaukee a plant is now under construction which will cost about $7,500,000. The city of Chicago is now constructing one large activated sludge plant, one plant which is a combination of the Imhoff tank and activated sludge methods, and another activated sludge plant is planned. These plants will have a capacity about three times as great as the Milwaukee plant. Still another activated sludge plant will take care of the peculiar type of sewage from the packing house district in Chicago.

It must not be imagined, however, that the activated sludge method, or any other, offers a panacea for the problem of sewage disposal. For not only do the requirements of different communities vary, but the character of the sewage itself varies. Usually the kind and degree of treatment required can be determined only after careful analysis. In cities on the ocean or other large bodies of water, as New York City, mechanical screening is often found sufficient, and a large investment in a disposal plant is useless. For this purpose several types of self-cleaning or mechanically cleaned screens have been developed. One of the most successful of these screens consists of a perforated cylindrical drum, mounted on a horizontal shaft, with the drum partly submerged in the raw sewage flow. The screened sewage, after passing through the perforations in the drum, flows out a discharge opening at one end of the drum. The drum is revolved mechanically, carrying the screenings beneath the drum to a screenings chamber on the other side, while a head of water within the cylinder creates a flushing action that makes the screen self-cleaning.

The settling tank, which is often used as a preliminary step for chemical or bacteriological treatment, will also often suffice as a complete treatment. The design of the settling tank has been undertaken in a scientific manner and carried very near perfection by American engineers. It is no longer necessary to drain the settling basin to remove the sludge, for the newest forms of settling tank are provided with a means for continuous sludge removal.

The most successful type of settling tank is round and comparatively shallow, the sewage being fed in at the center of the tank instead of the edge. This produces an even, slow flow from the center to the circumference of the tank, preventing swift currents or eddies which might pick up the lighter sludge from the bottom and carry it away with the effluent. The incoming stream tends to diffuse over the entire area and the solids settle to the bottom. Four arms revolve slowly around the bottom, each carrying a set of "plows" or "sweepers" which slowly push the accumulating sludge toward the center of the tank, from which point it is either flowed away by gravity or is pumped away for disposal. These settling tanks have been built in sizes from 6 feet to 225 feet in diameter.

Modern sedimentation tank, showing plows on bottom to collect sludge

It will thus be seen that the American sanitary engineer is ready with a sewage disposal system for village or great city. His services are equally valuable to certain industries and in general the same types of apparatus are being successfully applied to wastes from tanneries, glue factories, gelatine factories, beet sugar factories, textile mills, dairy products plants, packing houses, rubber reclaiming plants, dye works and others.

The Pneumatic Hub

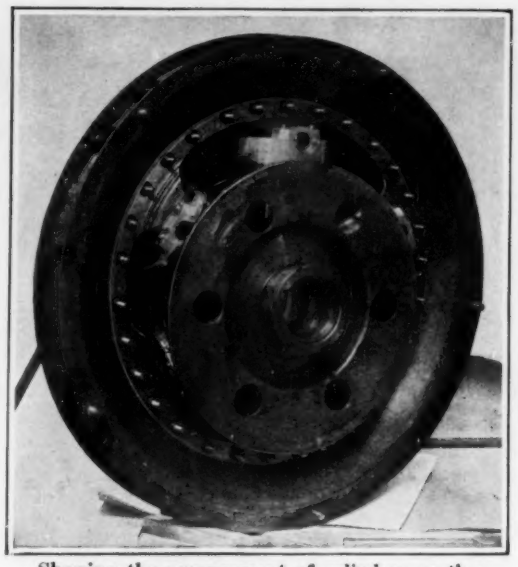
IT is a fact known to every motor-car owner that even the best of springs and the largest wheel profiles are on poor roads unable effectually to damp those heavy shocks and jerks which, especially if acting in a horizontal direction, are bound to exert a most prejudicial effect on the chassis and all parts of the car, particularly the motor.

The pneumatic hub designed by Boris von Loutzkoy and recently shown in Berlin is intended to absorb any shocks acting on those parts which are not spring-suspended. In fact, this hub will separate the drive-shaft from the wheel itself, so that the weight of the rear axle no longer acts on the latter, while any shocks reaching the wheel are absorbed before being able to pass on to the shaft. Inasmuch as the pneumatic hub works in all directions eccentrically to the car axis, it not only deals with vertical shocks, but even with those striking the wheels in a horizontal or tangential direction.

Moreover, it is claimed that the pneumatic hub at the same time insures a remarkable saving of energy and, accordingly, a saving of fuel; that it will accumulate the energy received with every shock, in order, at the following rotation of the wheel, to yield it up again to the motor and the whole plant.

The compressed air which, in the case of the pneumatic hub, serves to insure an efficient spring effect, is produced automatically during the motion of the car, air compressors (cylinders) being arranged radially between the spoke ring and axle bush. On stopping the car these air cylinders are discharged, the axle then lying eccentrically below the wheel centers. As soon as the wheels begin turning the cylinders fill with air. The axle now rests on air cushions throughout and is automatically washed by air. Inasmuch as the air-compressor cranks are under tensile strain, the wheels are automatically adjusted by the weight of the car, the upper cylinders, not working under pressure, being by the action of the power plant adjusted to suction. As soon as the cylinders during the rotation of the wheel reach their lowermost position they will compress the drawn-in air. All cylinders work without valves, thus insuring the greatest possible safety of operation.

The cranks also carry along the rear wheels by compressing the air in all cylinders. In fact, the power transmission from the engine to the wheels is purely pneumatic. With any rotation of wheels, especially in the case of braking, as well as with any shock or jerk, there is likewise a compression of air in all cylinders, thus producing by mechanical means a similar condition as in the case of the absorption of shocks by pneumatic tires.—*By Dr. Alfred Gradenwitz.*



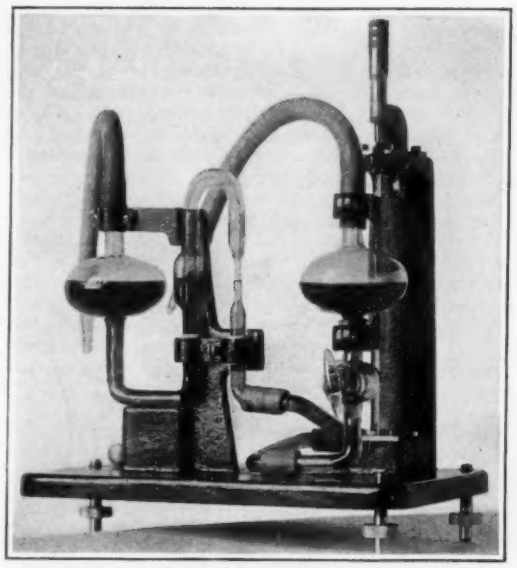
Showing the arrangement of cylinders on the pneumatic hub

Offset Printing on the Pavement

OFFSET printing as applied to the production of the SCIENTIFIC AMERICAN covers was explained to our readers in our November issue, so they are familiar with the general characteristics of the method. We illustrate a curious application of the principle on a much larger scale along the Paris boulevards. A large apparatus identical with the ordinary garden roller, save that the cylinder is of rubber in place of copper, is the means whereby the new trick is accomplished. On the surface of this roller large display advertisements are printed. By means of an ingenious wetting apparatus, as this roller progresses over the pavements the dust of the latter is dampened and a perfect series of printed duplicates of the story on the roller is left behind it. In the case that attracted our photographer's attention the subject of these novel notices was the motion-picture play of the hour; but the technique is plainly applicable to almost any topic.

Investigation reveals the fact that this idea is not entirely new. It was shown, in somewhat crude form, in these columns some twenty years ago.

The latest style in perambulating advertisements, fresh from Paris



Accurate measures of low air-current speeds are made possible by this apparatus

Forty-eight Speeds

FORTY-EIGHT different speeds—suggestive of a race horse or a touring car—is the variable capacity of a piece of machinery designed and installed at the intermountain experiment station of the United States Bureau of Mines, Salt Lake City, Utah. This unit for injecting chloride—a gas compounded with potash, soda, etc.—together with a rotary kiln, dust chambers, and a precipitator, comprises a miniature plant for the experimental dressing of ores by an evaporation process.

The chloride injector, or that part called the screw feeder, is capable of feeding from two and one-half to twenty ounces of chloridizing reagents an hour. Precision demands a positive gear action, rather than mere throttle control; and 48 speeds are called for. This unusual number is made possible by a system of sprocket wheels of different sizes. In the absence of commercial apparatus of the kind desired a scientist of the Bureau of Mines visited a store dealing in second-hand bicycles. Here he obtained a series of bicycle sprockets and arranged them into a set of gearing which gives the 48 speeds.

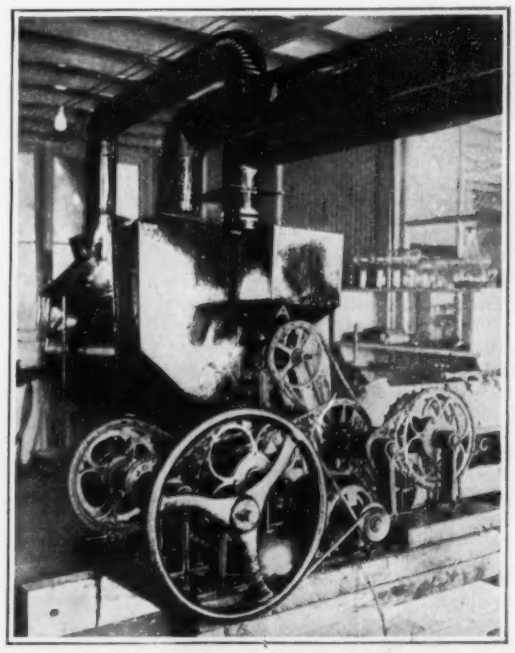
Measuring Low Air Velocities

ONE of the most delicate recording instruments used in scientific work has recently been perfected by F. G. Wahlen of the Illinois Engineering Experiment Station. In the course of experimental work at the University of Illinois laboratories the problem arose of how to measure low air velocities ranging from 2 to 7 feet per second under conditions where the total quantities of air in motion were relatively large, aggregating between 40,000 and 90,000 cubic feet per hour. In these instances the total head for producing flow was extremely small. It was essential to develop some instrument which would offer no frictional resistance to air flow and which would be extremely sensitive, accurate and readily portable.

After months of effort Mr. Wahlen developed such a gage, which is so sensitive that instantaneously it will respond to the most minute fluctuation in pressure. This delicate gage consists of a rigid base set on three leveling screws to support two large glass bulbs which are joined together by an inverted U-tube of peculiar shape. The right-hand leg of this tube is constricted, while the left-hand leg is enlarged at the plane where the liquids meet. The left-hand bulb is attached rigidly to the base, while the right-hand bulb moves vertically up and down with the carriage to which it is attached. The motion of this carriage is regulated by practically frictionless guides which eliminate all sidesway. The entire movement is controlled by means of a micrometer screw. Pressures are communicated to the two bulbs through flexible connectors on the top of each bulb. The bulbs and the U-tube are about half filled with alcohol which is colored red with aniline dye. The upper part of the U-tube is filled with clear kerosene and ligroin mixture so that its specific gravity is less than the density of the colored alcohol.

When in use the gage is first balanced at zero with both pressure connections open, care being exercised to adjust the position of the apparatus by operation of the leveling screws so that it is exactly level. After the gage is properly balanced pressure connections are made and the movable carriage and the liquid bulb are so manipulated that the meniscus is brought to the original reference line when a second micrometer reading is taken. The difference between the two micrometer readings when multiplied by the density of alcohol gives the pressure head in inches of water. A final zero reading is then taken to check the initial zero figure. A thousandth of an inch movement of the micrometer screw moves the meniscus 1/16 of an inch.

Because no movement of the measuring liquid occurs, no corrections are necessary on account of capillarity, viscosity, variations in bore of the tube or conditions of the glass surface. The sensitivity of the gage depends on the relation between the areas of the constricted tube and the large cross-section of the bulbs, upon the viscosity characteristics of the two liquids and the small density differential, as well as upon the fact that the constricted portion of the U-tube is very short. This gage is used as a direct-reading instrument for measuring and studying the velocities of outflowing air in furnace pipes, ventilators and similar conductors.



An improvised variable-speed injector with 48 speeds

Left: A prize specimen of the flying fox or fruit bat of Ceylon, and the hunter who has just brought him down. *Right:* A large colony of these creatures, hanging by their toes, head down, in a tree, and giving the impression of large fruit of some description

The fruit bat of Ceylon, individually and en masse

The Bat Pest in Ceylon

THERE are certain creatures from which the average human instinctively shrinks. There seems no very good reason why a rat or a mouse should be more terrifying than a squirrel or a chipmunk, but the female of the human species is not swayed by reason in her impulse to seek the high level of a chair seat and make loud noises of terror in the presence of the former animals and not in that of the latter. Likewise one of us who can deal most heroically with waterbugs and cockroaches may be reduced to a shuddering mass of inarticulate flesh at mere sight of a spider.

For those who are subject to it at all, the terror of bats is perhaps as acute as any of these fears. We have even gone to the trouble of inventing a tale to the effect that the bat will get in our hair and can not then be disentangled save by the heroic process of shaving. We can imagine that, once thoroughly enmeshed in a lady's hair, a bat might have to be shaved loose; but why the universal belief that such a fate is his chief aim in life?

All of which is by way of preliminary to the statement that the thousands of objects suspended in the tree of the accompanying photograph are not some strange exotic fruit. They are neither more nor less than one of the vast hordes of fruit-eating bats with which Ceylon is infested. They spend the day hanging in this fashion, head downward—thereby justifying at least one of the traditions connected with the tribe. The darker hours they devote to the serious business of raiding the fruit crops.

These bats have made such a nuisance of themselves that the Ceylon government has found it necessary to make a vigorous effort to reduce them, if not actually to exterminate them. So official bat hunters have been appointed, who make it their business to combat the flying rodents. The quick and easy method of poison is hardly available, because the fruit which it would be necessary to poison to reach them is intended for human consumption; so the campaign is mainly one of shooting. The bat's comparative inactivity during the daylight hours simplifies the issue somewhat.

The particular species involved in this little war is the one commonly known, not as a bat at all, but as "flying fox." That it attains to very respectable size is indicated by the prize specimen of our first picture, which the successful hunter has been at pains to nail neatly to the tree for the camera's benefit. The actual body and head, of course, are small; the size lies mainly in the wings. The animal hangs from his forefingers at the upper end of these, with his body suspended, head down, at a considerable distance beneath the limb. It is the wing which is then visible, and gives the effect of a large fruit of some sort.

Effects of Liming on Soil

DISCUSSING the results of investigations made by himself and many others of the effects of liming on the availability of soil potassium, phosphorus, and sulfur, Mr. J. K. Plummer in the *Journal of the American Society of Agronomy*, says: More recent research, embodying laboratory extractions with weak solvents, pot studies using a variety of plants as indicators of the concentration of the soil solution in potassium and the analyses of their ash, lysimeter experiments from which the outgo of potassium has been measured, and field tests, have failed to show that basic compounds of calcium and magnesium increase, by chemical action, to any practical extent, the availability of the soil store of native potassium. As measured by yields, phosphates of iron and aluminum seem to be as available as calcium phosphates. It is very probably true that fixation of phosphatic fertilizers by colloidal absorption induced by iron and aluminum oxides is responsible for the failure of some crops to respond to phosphorus additions. Additions of lime on such soils undoubtedly flocculate some of these colloids, which gives the soil a better physical condition for plant growth.

Additions of lime, before or after applications of soluble phosphates, have greatly increased the efficiency of the phosphatic fertilizer. When insoluble calcium phosphate has been applied it seems that applications of lime have reduced the effectiveness of the phosphate in the majority of cases.

The scant data of lysimeter experiments only, which deal with the question of sulfate availability or conservation, seem to show that liming, with small amounts of CaO, both small and large amounts of MgO, $MgCO_3$, limestone, dolomite, and magnesite, increases the solubility of native soil sulfate. Heavy applications of CaO, for a few years at least, apparently reduce this loss of sulfur from the soil.

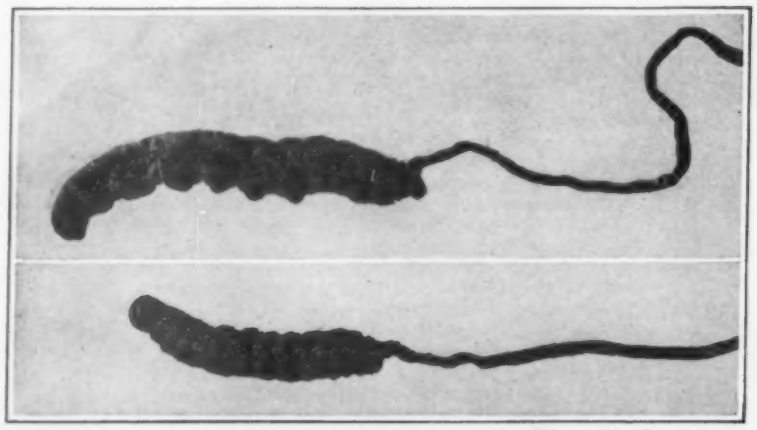
The Relation of Nutritive Constituents to the Composition of Oat Plants

AS a result of a series of interesting experiments made to determine the relation of certain nutritive elements to the composition of the oat plant, and published in the *American Journal of Botany* for May, 1921, Dr. J. G. Dickson of the University of Wisconsin finds that the calcium content of both grain and straw is reduced to about 10 per cent of that of the plants from the controls by reducing the calcium in the culture solution to one-tenth the quantity present in the complete nutrient solution. It is greatly reduced in both grain and straw by a similar deficiency in phosphorus or in nitrogen.

The total phosphorus content of the grain is reduced to 46 per cent, and of the straw to 10 per cent, of that in the plants from the controls by reducing the phosphate in the culture solution to one-tenth of the quantity present in the complete nutrient solution. It is slightly reduced in both grain and straw by a similar deficiency in potassium, and is increased by a similar reduction of calcium or nitrogen.

Although the variations in composition are more pronounced in the straw, yet in general they are similar in both grain and straw.

The phosphorus content of both grain and straw is modified by seasonal differences, except for the plants grown in the phosphorus-deficient solutions. The calcium content of the grain is modified by seasonal differences even in the calcium-deficient solutions. The calcium content of the straw, however, shows no consistent response to climate.



These were once caterpillars; now they are plants with stalks, the spores having taken possession of the caterpillar's body and fed on his internals

The Vegetable Caterpillar

FUNGI that take possession of the bodies of caterpillars and worms are among the interesting phenomena on the borderland between the vegetable and animal kingdoms. Our illustration shows two excellent specimens of the so-called "vegetable caterpillar" of New Zealand. The larger one measures about three inches in length and the shorter one two inches. The stalks or stems are approximately ten and six inches, respectively.

The origin of the vegetable caterpillar, if we are to credit local accounts, seems to have some connection with the rata tree, a parasite of somewhat singular characteristics. The rata seed borne through the air takes root in the fork of its host tree, gradually crushing the life out of it by sending out encircling feelers and finally assuming the shape of a legitimate forest tree. It is under the rata tree that the vegetable caterpillar is found. Its presence is detected by a sharp tail-like spike extending above the surface of the soil. It is said that the (animal) caterpillar feeds upon the rata foliage and ultimately drops to the foot of the tree, where it bores itself into the earth. But the rata spores have entered via its breathing tubes, and soon eat it up all save the outer shell. From the back of the head springs the fungus, terminating in a point covered with the fruit. The viscera, upon investigation, will be found to be entirely displaced by a chalky fungoid substance. The only semblance to the original larva is the outer skin, which maintains all the outlines of its former inhabitant.

This larva fungus is also found in Tibet, as recorded by Dr. A. L. Shelton, for seventeen years medical missionary at Batang, in a recent issue of the *National Geographic Magazine*. He described the "grass worm," highly prized by Tibetans for supposed medicinal virtues, exactly as we have outlined the vegetable caterpillar of New Zealand.—*By George F. Cornwall.*

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Fiber Container Industry

MR. J. D. MALCOLMSON, in the August and September numbers of *The Chemical Age* (New York), discusses the fiber container industry and the application of industrial research to some of its problems. The methods employed in studying fibers involved microscopical tests so that various kinds of paper fibers might be identified. This included the perfection of a new stain. All the other laboratory tests, such as certain physical and chemical ones, proved to be informing, but so far as the consumer is concerned the ability of the materials to withstand freight handling and the ordinary usages to which containers are put is of more direct importance. A new test known as the Webb test has been developed, with which each side of the corrugated board may be tested separately. A drum box tester was constructed with a set of scientifically placed baffles which compel the loaded box under test to drop on each side and corner, thus duplicating the average treatment in use. In this drum more than 1300 fiber boxes of all varieties with different loads have been tested and results have enabled specifications to be based on facts.

Optical Method for Oil Analysis

THE July issue of the *Cotton Oil Press* describes an optical method for determining oil in all oil-mill materials. The method consists of grinding in a warm mortar two grams of a sample containing a known oil with three of Halowax oil. A portion of the liquid is then removed by drawing it through a plug of cotton in a tube and the refractive index of the mixture is determined. This operation requires about eight or ten minutes. The percentage of oil is obtained by reference to a table or chart prepared from readings of mixtures of known proportions of the solvent and the oil in question.

The accuracy of the test has been demonstrated by comparing results with those obtained by the extraction method and the difference was found to be but one point in the second decimal place. This rapid method should make possible the purchase of oil-bearing materials on the basis of their oil content, which has not been the practice in general heretofore. Besides this the superintendent of a crushing plant can have frequent analyses made of his various products, can know how efficiently his machinery is operating, and can be aided in establishing a certain control over operations.

Pink Cottons

IT is not unusual to have bleached cottons assume a pink coloring either at the bleachery or shortly after being removed. A short time ago a merchandising house began to send complaints from various departments to the laboratory appealing for information both as to the cause and the cure of pinkness in case after case of cottons drawn from the warehouse. The first troubles were referred to the bleacheries, but when materials of all kinds were found colored it became evident that the trouble lay in the warehouse. Remembering that white canvas shoes often turn pink when aniline has been used in curing the rubber soles, investigation was made of all cases stacked near a large stock of rubber tires and nearly all found to be affected.

This is but another example of the great influence of small quantities of some compounds. About three ounces of aniline oil were used in each 70 pounds of the rubber compound which caused this trouble, and the injured goods were wrapped, boxed and packed in approved fashion. Some believe that the pink color occurs when aniline comes into contact with hydrocellulose formed when overbleaching occurs. Others argue that the color is most pronounced when furfural is present, and this compound is likely to be found in small amounts wherever starch is used, as in finishing dry goods.

Various methods for removing the color have been proposed, all being aimed at bringing about a change without actual refinishing. This suggests the use of gases in a way to form minute quantities of fixed alkali in the goods. Unfortunately it is difficult to convince the public that the coloration under discussion is not injurious to the goods and will disappear with the first washing.

Lithopone

IN the August number of *Chemical Age* there is printed a short article on lithopone which serves to remind us how important this pigment has become. More than 85,000 tons of barytes were used for the manufacture of lithopone in 1918 as contrasted with less than 45,000 tons in 1915. The process of manufacture consists in bringing together barium sulfide in solution with purified zinc sulfate, heating and mixing with the result that an insoluble precipitate is formed consisting of 68 to 70 per cent barium sulfate and 30 to 32 per cent of zinc sulfide. This precipitate is dried, then heated red hot and quenched. This is the delicate part of the process, changing the constitution of the powder and making it opaque and white. Finally it is ground in water and floated. During heating some of the zinc sulfide is changed to oxide so that 1 to 10 per cent of the final product is zinc oxide.

Lithopone is whiter than white lead and equal to the best grade of zinc oxide. It is not affected by sulfur or hydrogen sulfide, is not poisonous and does not blacken by combining with lead contained in pigments or driers.

Beet Molasses

H. W. DAHLBERG in discussing the chemical problems of the beet sugar industry in *Chemical and Metallurgical Engineering* points to the possibilities in the by-products from the molasses which are not suited for human food. The ash in molasses contains nearly 50 per cent of potash as K_2O which may be recovered by evaporating the waste matter from the Steffens process, where the sugar is recovered as saccharate, and burning the thick liquor, leaving the ash, which may be used as a fertilizer or worked up into potassium carbonate. The vegetable carbon is useful as a decolorizer. This simple process takes no account of the nitrogen, present in the waste water, which should yield methylamines, cyanide and ammonia. Attracted by the demand for dimethylamine as a vulcanizing accelerator, research is in progress to determine the best ways to secure high yields and pure products of this class from molasses.

The author considers the following as possible molasses by-products: sugar, potassium carbonate and sulfate, sodium carbonate, carbon, methylamines, sodium cyanide, ammonium sulfate, methyl alcohol and vegetable tar.

Fixed Nitrogen

AMONG the methods of fixing atmospheric nitrogen is the one which depends on the conversion of alumina into aluminum nitride and a patent has been issued to Mark Shoeld on an improved technique. The calculated quantity of carbon and finely ground alumina is made into briquettes which are then mixed with larger pieces of coke. This mixture is fed continuously through an electric furnace equipped with stationary electrodes. Producer gas, providing the nitrogen, is admitted through inlets. The larger pieces of coke carry most of the current serving to produce the temperature for the reaction and at the same time prevent the fusion together of the briquettes which are later separated from the coke by screening. The coke is used repeatedly until worn to a size too small to facilitate separation from the briquettes.

A Shell Game

POULTRY requires charcoal in various sized pieces as a part of the ration, and it has been customary to use willow charcoal for the purpose. Many tons of this commodity are sent into southern California yearly where the disposition of walnut shells has been a problem. It has remained for the chemical engineer to convert the shells into the charcoal for which there is the demand. The manufacturing plant is simple, consisting of a 10-inch by 10-inch rotary kiln into which the ground shells are fed through flame into a hot zone where the dust is burned away. The kiln is fitted with baffles and lifters to secure proper mixing, which is essential to uniform charring. Tar is distilled off and the charcoal, quenched as it leaves the kiln, is screened into four, six and ten mesh sizes before sacking. It is of excellent quality for poultry, more gas absorbent than willow charcoal, and dust-free. One ton is produced for each three tons of shells. Creosote, oil and pitch can be made from the tar recovered from the flue gases. The venture is very profitable.

Experiments are now under way with fruit pits, shavings, etc., and it may be that the process will offer a simple solution in the case of other wastes.

Iron Tanning

THE Journal of the American Leather Chemists' Association abstracts an article by G. Grasser on the chemical control of iron tanning.

"The use of iron salts for tanning has increased to such an extent that manufacturers have begun to prepare iron tanning extracts on a commercial scale. The leather chemist is now called upon to establish methods for controlling the iron liquors as well as for analyzing the extracts and leather. It is important to regulate the concentration of both ferrous and ferric iron in the liquors during tanning. Iron tannages may be readily detected by moistening a cutting with a solution of acetic acid and tannin, which changes the color from a brownish red to a bluish black. The leather may be analyzed by methods commonly used for chrome leather, the important determinations being water, ash, ferric oxide, calcium oxide, total acid, sulfuric acid, fat and hide substance. The ferric oxide content of seven leathers examined varied from 9 to 37 parts per hundred of hide substance."

Unburnable Balloon Gas

THE work under direction of the U. S. Bureau of Mines on helium production has attracted much attention because we must have unburnable gas for dirigibles if balloon navigation is to have a satisfactory degree of safety. But helium at best is expensive and may not be available in sufficient quantity so that a gas mixture is desirable. It has now been found that 18 to 20 per cent of hydrogen may be mixed with helium and still produce a mixture which will not burn with a persistent flame when flowing from an opening under conditions similar to those present in balloons. When the percentage of hydrogen passes 14 the gas mixture can be ignited under favorable conditions, but combustion is not supported.

Preserving Mine Timbers

GREAT quantities of mine timbers are being placed in American mines without preservative treatment, notwithstanding the fact that 10 years is about the average length of life of such wood in service. In one experiment 80 per cent of the treated timbers were still sound after such length of service and none needed replacement. A note from the Forest Products Laboratory says:

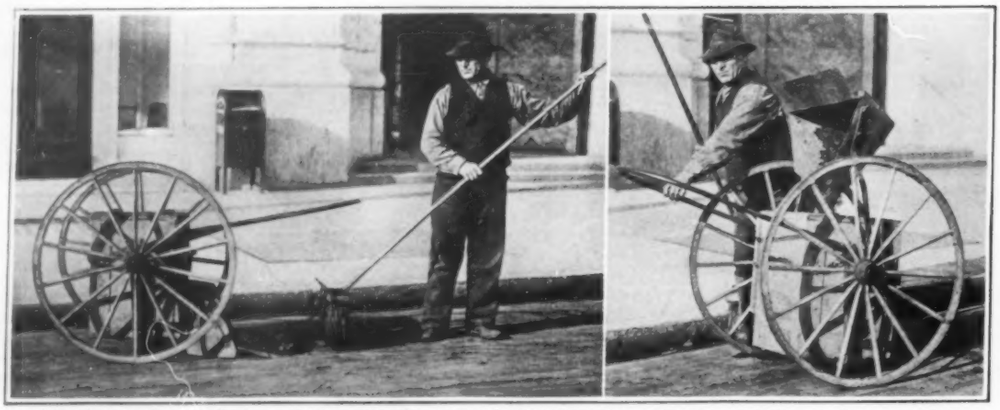
"At least three preservatives have been found suitable for mine work. These are coal-tar creosote, zinc chloride and sodium fluoride. Creosote is the most effective in preventing decay. Timbers thoroughly impregnated with it are likely to resist decay until they are crushed or worn out. Occasional objection is made to the possible fire hazard of creosoted wood, but long experience indicates that the additional fire risk is very small. Zinc chloride and sodium fluoride are odorless, and if anything they tend to reduce the inflammability of wood. They are cheaper than creosote, and although they do not give such permanent protection they greatly increase the life of timbers. Coal-tar creosote may be applied by the brush, dipping, open-tank or pressure methods. Zinc chloride and sodium fluoride may be injected by the steeping, open-tank, or pressure methods. The cost and effectiveness of the methods of treatment increase in the order given. The saving possible with any of them is so great that it will pay every mine to adopt the use of some preservative on permanently located timbers."

Artificial Stone

A BRITISH patent for a new artificial stone specifies nearly equal parts of porcelain or faience refuse, powdered pipe clay and crushed glass as suitable materials. These are mixed with water and placed in a mold, the bottom of which is covered with the glass. Pressure is applied and the mixture then heated to 900 or 1200 degrees. The result is an artificial stone, marble-like and with a glazed surface. Various colors are easily possible.

The Street-Cleaning Buggy

MOST of us have seen the street cleaner traveling back and forth through the street with his long-handled brush and his shovel, and his little wheeled cart into which he shovels his accumulation of filth; or perhaps he will have been pushing before him a scraper with broad flat blade and guard at the back, taking the place of broom and shovel. This is an improvement over the simpler scheme, but it still makes it necessary for the white-wing to dispose of the loaded scoop by emptying it into a cart of some sort, and this in turn makes it certain that he will lose a lot of time in handling the cart.



Left: With the flap side down, in position to take the sweepings. *Right:* Turned over the other way to be moved to a new point

The street-cleaning buggy that reduces sweeping and shoveling to a single operation

San Francisco has just installed a "street-cleaning buggy." At first glance this device might seem to be a step backward, since it returns to the old broom, which obviously can not itself make final disposition of the material it sweeps. But the trick is not in the broom at all; it is in the construction of the cart. As is so often the case, this is merely a metal barrel slung between wheels; but it has a wide, flat lip which swings with the long handle, while the barrel itself remains fixed on the axle. The sweeper wheels this contraption to the proper point and then throws it over its own head into the position shown in our first view. He sweeps directly into it, via the flat lip, and when he is ready to move he throws the lip and the handle back over the barrel. This discharges the results of the sweeping into the barrel, and restores the whole apparatus to the appearance and the function of an ordinary two-wheeled cart, which he then trundles to the next point of attack. Sweeping and shoveling are thus reduced to a single operation, and much time saved. The device can, of course, be used only on asphalt or comparably smooth pavements, but this does not seriously restrict its application in our largest cities.

The One-Piece Living-Room Suite

DOUBTLESS it is the small modern apartment which is responsible for the vogue of the combination phonograph, step-ladder and bathtub, or its first cousin that can be converted from an ornamental lamp-stand into a highchair for the baby, and from that into a clothes drier, by a twist of the wrist. But ridiculous as some of the combinations actually offered are, there is really a germ of utility in them; for if we have room in the apartment-ette for only a single piece of furniture, it really is rather essential that this piece be made to serve several ends.

We illustrate a rather ingenious member of this combination family from France. As it stands it is not difficult to realize that the foot of this rather elegant bedstead can be capsized into the head to give us a highly ornamental sideboard. And we have then the photographer's word for it that if we turn it about and put its face to the wall it will show us, not a back, but another face, which shall be nothing less than a bookcase. We suspect that what he means is that the upper half swivels about and reveals a half-length bookcase; we have our doubts that there is room in the bottom of the apparatus for the mattress and for rows of books in addition, even if the mistress of the house were to find it entirely convenient to turn it about from the floor up. And even so, it seems fairly clear that there will be no accommodations here for Webster's Unabridged, or any volume approaching it in depth. Still, there must be some drawbacks about living in a one-room apartment, and doubtless some compensating advantages. This bedstead-plus surely makes the most of the latter.

A bed or a sideboard at pleasure from the side shown, and a book-case by turning it around

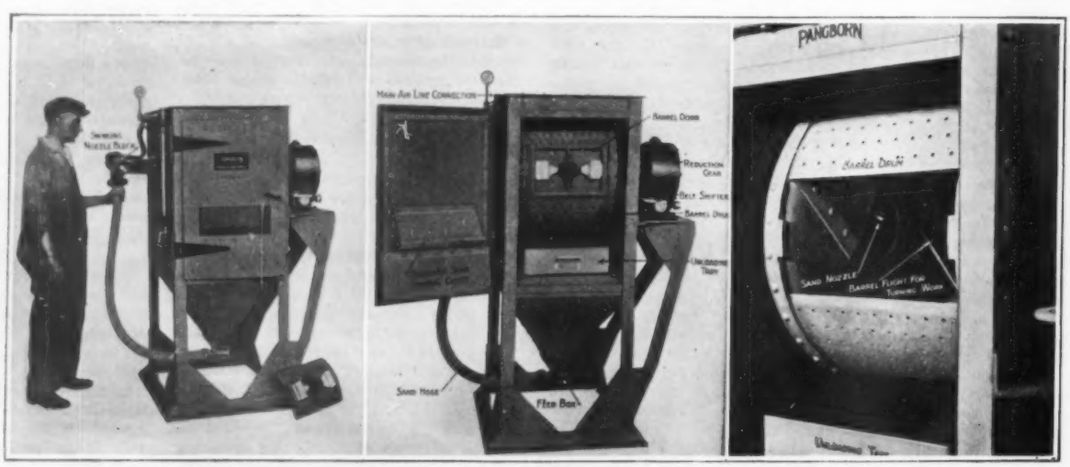
Lichens That Eat Church Windows

THE deterioration which sometimes takes place in church windows is due, in many cases, strange as it may seem, to the growth of lichens upon the glass. No less than 19 species of these lowly plant forms, which consist of an alga and a fungus mutually interdependent, have been identified as making their habitat upon the glass of church windows, and they seem to thrive upon this sort of artificial rock to such an extent as actually to injure the glass. A French woman, Mlle. E. Mellor, who has been studying this curious phenomenon, has made a report upon the subject, which is published in the records of the French Society of Biology, for April 16, 1921. She states that while it is usually the exterior surface of the glass which is attacked, the lichens sometimes develop, at the same time, upon the interior surface. Her observations have led her to conclude that the roughening or "eating" of the surface of the panes of glass is directly due to the carbon dioxide set free by the lichens.

Sand-Blasting Small Parts

ONE of the mechanical facilities offered the modern technical world which has not been taken advantage of to the apparent full extent of its possibilities is the sand-blast. It ought to be sufficiently evident that much time could be saved in many grinding operations, and even sometimes in light machining, if equipment were to be had for the suitable sand-blasting of small parts as a preliminary to these operations. It seems as though in nearly every industry the sand-blast might find a wider range of use if apparatus were available which should at once be practical and efficient and small enough to handle economically the numerous small parts that are being continually ground, machined, heat-treated, galvanized or otherwise worked.

It has in the past been only too true that sand-blasting machinery was for the most part too expensive in first cost, too bulky and too costly in operation to do such work. An effort to meet this need is now being made, however, by a Hagerstown, Md., manufacturer, who has put out the small and compact unit illustrated herewith. The device consists of a sheet-metal dust-tight cabinet on a structural frame, the bottom being hopper-shaped to receive the abrasive, and equipped with a feed-fox to which is attached a hose that conveys the sand to the nozzle. The barrel drum mounted within this cabinet is 24 inches in diameter by 16 inches long, of perforated sheet-metal. The shaft on which it runs is geared in reduction by worm to the main driving shaft, which in turn is equipped with tight and loose pulleys and belt connections. The interior of the barrel is fitted with baffles, which turn the load as it rotates slowly, bringing all pieces and all faces under the blast action. The spent abrasive drops through the perforations of the drum. The whole outfit seems a model of compact neatness, and should be an addition to any machine shop.



A sand-blast cabinet designed for small, light work, showing the outfit in use and two internal views of its construction

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A 750-Gallon Tank Plus a Motor Truck for Transporting Ink

THE desirability of shipping in bulk and eliminating the use of small containers has long been recognized. However, transporting ink in a 750-gallon tank would hardly seem feasible to those of us who consider a pint bottle of this commodity a large quantity. Nevertheless, an ink manufacturer of Hoboken is using a large tank-truck of this capacity to supply New York newspapers.

In a modern newspaper building ink is stored in a tank near the roof. This tank is connected with the presses by means of pipe lines. The ink manufacturer's truck delivers ink in bulk, attaching a hose to the filler pipe outside of the building. Through this pipe the ink is rapidly pumped up to the storage tank.

When the sales engineers of the motor truck company first considered transporting ink in bulk, they were forced to find some method of preventing the ink's congealing in cold weather. This difficulty was satisfactorily overcome by passing the exhaust pipe of the engine through the tank.

Scoop Body for Motor Trucks Has Many Advantages

IN the building of highways and the transportation of building materials, a scoop body for motor cars to facilitate work and lessen the pay roll was recently invented.

The device is a simple all-steel self-dumping body specially designed for small motor trucks and can be attached to the chassis or detached in a few minutes by means of four bolts. The scoop is so constructed that it can be used as a single or double unit, as shown in the accompanying illustrations. The body is self- or gravity-dumping in operation.

It is particularly adopted for hand loading and dumps itself when a latch for this purpose is tripped, rights itself by means of springs after it has deposited its load and then locks automatically. The dumping and righting is accomplished without the necessity of the driver leaving his seat. The scoop is built low to meet all requirements of the overhead hopper.

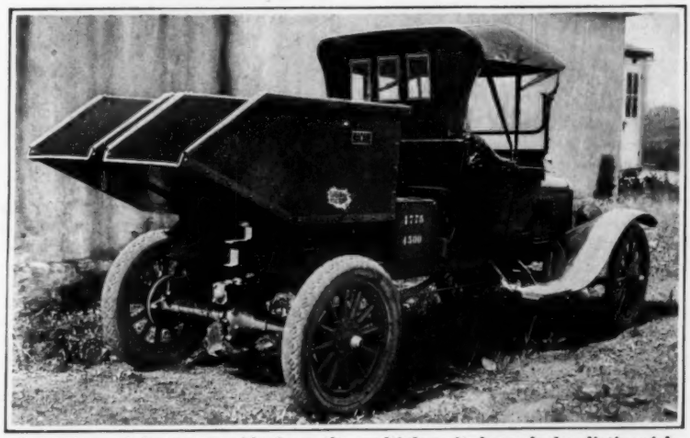
By reason of a steep angle of dump tail end, the discharge is clean and shoveling out the dregs is never necessary. The final shock of the dump, which clears the body, is sufficiently cushioned by the spring in the check chain to prevent damage to chassis or body. The body itself is made of ⅛-inch steel plate throughout, with smooth rolled and welded steel reinforcing flanges around the top. The bottom is also heavily reinforced by angles. The whole device is built for long durability.

Two-ton truck used in general farm work outside of well-built garage used to house it

Farmers a Potential Truck Market

AGRICULTURE is the most important activity that human endeavor has, but it receives the least attention, so far as transportation goes. When conditions become normal again and the farmer is not handicapped as he is at present by having to sell his produce at low cost and pay high prices for the commodities he needs, there will be an enormous market created for motor trucks in the agricultural industry, just as there is now in manufacturing industries.

Census figures show that the total number of farms in the United States is 6,361,502, of an average size of 140 acres. It has been stated that any farm of 80 or more acres can use a motor truck profitably. Adding a factor of safety of 75 per centum to this estimate, it is concluded that a farm of 140 acres can economically support a motor truck. It is, therefore, reasonable to assume that if every 140 acres of farm land will support a motor truck, the possible number of motor trucks that may be sold is 6,361,502. To be conservative, suppose that only one-third of this number would be motor truck prospects; we thus find a potential market for 2,120,500 motor trucks. Comparing this number with the number already in use, we find that only 3.2 per centum of the potential market has been sold on the actual use of the motor truck.



Several novel features, aside from the multiple-unit dump body, distinguish this new dump truck

The fact that motor truck hauls during a certain period from farms to shipping points averaged 11.3 miles, while horse and wagon hauls averaged 9 miles, and that the motor truck made 3.4 round trips over the longer route, while horses made 1.2 round trips over the shorter, is evidence enough that the motor truck is needed on the farm. In the bargain, truck hauling of wheat costs 15 cents per ton-mile, against 30 cents by horses; with even more favorable figures for cotton.

Truck Carries Complete Furnishings for Six-Room House

AN organization of furniture packers and movers of Boston recently placed in service a motor truck that is unquestionably one of the finest vehicles devoted to furniture hauling in America. This de luxe moving van consists of a special enclosed body mounted on a 3-3½-ton White chassis. The truck is used almost exclusively for long hauls between Boston and Philadelphia, New York, Washington, Baltimore and other points. It is fitted with sleeping quarters for three men. This enables one man to drive while others sleep and keeps the truck on the road day and night.

This truck carries furniture between Boston and Philadelphia, New York and Washington

The body is constructed without the interior padding common to furniture trucks. Removable boards divide the storage space into compartments, with provisions for tying the load through apertures in the bottom of the body. The driver's compartment, which includes the berths, is entirely enclosed and the entire car fitted with electric lights. The complete furnishings of a six-room house can be loaded into the van, 1000 cubic feet of cargo space being available.

Moving Sixty Thousand Bushels of Peaches to Market

IN handling highly perishable fruit crops, notably peaches, motor trucks are being used to great advantage. Fruit growers constantly are adding to their truck equipment. As an instance, one Georgia grower has purchased 37 trucks in the last two years.

At the largest nursery and peach-orchard "plant" in the United States, Berlin, Md., two trucks carry the entire crop of 2500 acres of peach trees—a crop that this year amounted to 60,000 bushels—from the orchards to the packing house, where it is loaded into refrigerator cars.

Pickers in the orchards pick the peaches into ⅝-bushel baskets and the two motor trucks carry the baskets to the packing house. Ordinarily the trucks each carry 150 to 175 baskets, and they make 12 to 15 trips a day each. On one particularly busy day one of the trucks made 13 round trips, carrying 184 baskets on each trip—and made two runs to an orchard four miles away to carry employes. On another occasion one of the trucks carried a force of employees to a subsidiary orchard at Easton, aided in picking and packing $16,000 worth of peaches, and carried its crew the 75 miles back across the Eastern Shore peninsula to Berlin—all in six days.

The peach season covers only a few weeks of each year. But throughout the year there is work at the Berlin plant for the two trucks. In winter they carry shipments of nursery stock to the railroad. Besides they haul fertilizer and other farm supplies and engage in the many and varied jobs of transportation that continually present themselves.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

London's phonographic hustler for use on crowded subway platforms

"Step Lively, Please!"

THIS and other cries now assault the ears of those who endeavor to clog the wheels of London's underground traffic by lingering on the escalators. They are shouted by a steel-lunged giant with a throat of brass, and there is no doubt of their efficacy. The apparatus producing them is known as the automatic stentorphone, and the Underground Railway Companies of London have just adopted them to minimize delay and congestion at the escalators during the busiest hours of the day. The name is appropriate, for surely Stentor, the Greek herald-god, would have been proud of his mechanical successor.

The device is a modification of the original stentorphone—an apparatus devised to reinforce and strengthen the tone given out by an ordinary gramophone record, so that it can be clearly heard over the whole of an ordinary ballroom, cinema, etc. The device acts by employing a strong blast of air, produced by a special blower, to produce and carry the tone. For ordinary use the stentorphone may be concealed in a cabinet of graceful design, yet by a simple and instantaneous valve adjustment the volume of sound may be cut off entirely or widely modulated. As has been said above, any ordinary gramophone record may be used, and so a full selection of band and chamber music may be rendered in a large hall or out of doors without the expense of hiring a band or orchestra.

The harassed dance promoter will find the new invention a great boon. A ballroom without a good band is hopeless, and a poor band is as bad as none at all. But good bands, alas, are expensive, and not always attainable. This is where the stentorphone steps in. It can fill any sized hall or room, and the volume of sound can be modulated to fill the exact size of the room in which it is playing. Further uses are in the cinema; the sound of horses' hoofs, for instance, may be exactly reproduced, and the sound made to die away in the distance as the horses in the picture recede. For election addresses to open-air audiences the stentorphone has no rival. A record once made, and the orator may address his electors in a hundred towns simultaneously and not one word will be indistinct. A form of the device suitable to outdoor use is seen in the illustration. Dainty concealed instruments in cabinet and other designs are available for indoor use.

The latest application, that to which we referred earlier, has been secured by the addition of automatic equipment which repeats the chosen phrases indefinitely. An automatic time-stop renders it unnecessary to give the instrument any attention whatsoever during the hours of operation. The London Underground authorities state that since its use there have been unprecedented order and rapidity among the huge crowds which tend to choke the escalators during busy hours. The result is that the platforms disgorge their passengers in much less time than formerly. It is, at all events, a strange experience to witness the violent start of the idling passenger when a giant voice, proceeding apparently from nowhere, adjures him to "Get a move on!" Perhaps we may look for an early adoption of the device in this country, and an assumption by the brass-throated monster of the subway guard's burden of imploring us to "Step right up to the middle of the car."

An electric cap for the draft-wary

For Him Who Fears a Draft

THIS invention is of value to one who wishes to protect his head—particularly if scanty of hair. It is an electrical cap, shaped like a Turkish fez, and is really of considerable value to one who wishes to sleep in an airy room or even on the porch in winter. The tendency of many people to draw their heads under the clothes after they have fallen asleep may be overcome by wearing this novel headpiece.—*By William Walsh.*

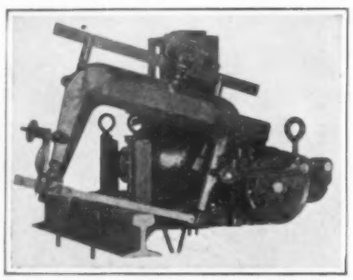
A bench furnace with many uses

The Bunion Shoe Tree

WE will naturally all admit that the shoe having a shoe tree in it when not on the foot is the best-looking shoe. These hollow metal shoe trees are adjustable and have an entirely new feature that makes them different from the others. On the right and left sides small metal buttons will be noticed. These are for the benefit of those who may have trouble with their shoes being too tight in particular places, causing corns to form. Anywhere a shoe pinches these metal buttons can be secured. They are said to succeed in stretching the leather over this point and making the shoe more comfortable.

The All-Around Bench Furnace

OPERATING direct from the gas mains this gas furnace is designed so that no blower is interposed, and besides heating soldering coppers it may be used for various other things. In the top of the combustion chamber a hole receives a twenty-pound melting pot for melting leads, babbits or other bearing metals. Swinging doors on either side of the combustion chamber facilitate the placing of long rods for heating any part of their entire length. A lid at the front of the combustion chamber almost completely covers the opening, and for inserting the soldering coppers a slit is provided at the top. The coppers are supported on a ledge in the rear of the chamber while being heated, and thus they are held clear of the bottom of the furnace and the tinned portion is out of the direct flame blast.



To cut rails as they lie on the ties

Sharpening Files by Electrolysis

BRITISH patent 161,611 of 1919, which has just come to our attention, reveals a method of sharpening files, rasps and the like by placing them in an electrolyte and applying a high-tension current capable of giving a spark of length equal to the average length of the files. The treatment lasts for a number of minutes corresponding to this length in inches. An induction coil may be used. A good electrolyte for the purpose is made with 36 parts water, 3 of nitric acid and 5 of sulfuric. The water and files go into the vat first, the acids being added after the current has been switched on. Before the treatment it may be desirable to wash the files, wire-brush them, give them an alkali dip, and dry them well.

Utilizing Old Film

THE emulsion, according to a recent statement by G. Bonwitt in *Chemische Zeitung*, is best removed with boiling water; acids, which accelerate the process, also damage the film body. Both the celluloid base and the washed-off gelatine are of commercial value. The latter is treated with sulfuric acid, and heated for perhaps half an hour; this causes complete precipitation of the silver bromide. The celluloid is mostly used in the manufacture of varnishes. Motion-picture film requires slightly different treatment; for here the celluloid base is most profitably preserved by recoating, and this requires that a more moderate heat be used.

A shoe-tree for the game foot

A Portable Rail Cutter

TWO men can easily handle this new portable rail-cutting machine, which is used for cutting rails without removing them from the track bed. An automatic lifting device lifts the blade free and clear of the work on each non-cutting stroke. The machine has a cutting stroke of six inches and operates at 100 strokes per minute. Operating current for the direct-connected motor is secured from a trolley wire or third rail. Quick acting clamping devices hold the machine firmly to the rail and secure a straight cut. It is automatic in so far that after the machine has started on a cut no further attention by the operator is necessary until the rail is cut through. —*By Allen P. Child.*

The One-Way Dust-Pan

ONCE the dust and other debris gets into this dust-pan it is there to stay. It can't fall or blow out until the house-cleaner so desires. It is

No dust can escape from this pan

With the pipe-stem at the top of the bowl, the sludge is kept completely separate from the smoke

to be especially noted that this pan is equipped with a top or cover. This may be raised or lowered by operating the lever at the top of the handle. With the cover raised the sweeper brings in with the brush all the debris into the receptacle. The device is self-locking, so that at times as desired the operator may have both hands free. One particular advantage in its use also is that no bending or stooping is ever required of the housewife who goes about her cleaning with the aid of this pan.

Easy on the Eyes

A MANUFACTURER of reading glasses of Indianapolis evidently became tired of holding the old hand-grasp design, for he has designed one that holds itself in the desired position over the page, leaving the hand of the user free for other things.

In the examination of fine print of any description, maps, etc., it will be found easy on the eyes. It has come into use for the examination of finger-prints in the identification of criminals and is found to contribute materially to the ease of this work.

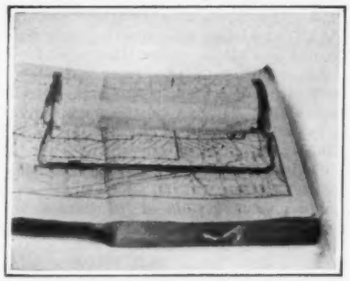
A New Idea in Valve Grinders

A VALVE grinder that operates in a way somewhat different from that known to the auto mechanic promises to cut down part of his monotonous labor in this process. The grinding edge of the instrument is made to rotate back and forth, but the hand of the operator —in this new device—always turns away from him, just as though he were working the crank of a grindstone. This is accomplished because the gears automatically shift back and forth, thus reversing point of application to the job.

The handle of this valve-grinder always turns in the same direction

A Pipe with the Stem at the Top

IN this newly designed pipe the condensable products of combustion commonly known as "sludge" or nicotine are separated from the smoke by gravity.



A self-supporting reading glass

The smoke is forced, by drawing on the stem, away from the sludge and rises through the open, spiral coil, which is formed in the coarse threads of the bowl to the smaller chamber above. It travels 20 inches from the beginning until it comes out through the stem.

The inventor claims the tobacco is always dry and therefore it is all consumed and none wasted. All sludge is held by gravity in the settling chamber, as will be appreciated upon examination of the broken-away drawing of the pipe which we present above.

Heater and Distributing Fan in One

THIS electric heater and fan form an unusual combination. By this method the heat is, of course, distributed more uniformly about the room. Both parts of the mechanism are of standard manufacture. Where it is necessary or desirable to place the heater upon a narrow table, shelf or other receptacle the compactness of the combination will be appreciated. Altogether, it seems to comprise a most happy combination.

The Newest Christmas Tree Lights

AMONG the Christmas novelties offered for the coming holiday season is a very convenient tree-lighting set which builds up in units of eight lights. In place of having to have 8-light, 16-light and 32-light sets, each entirely distinct from the others, we may now build up to these or to any number which our fuses will support by simply screwing the plug of one 8-light set into the socket of another. If an extra bright light is desired on any tree an ordinary lamp-bulb can be placed in the end socket in place of the special Christmas tree bulbs with which the set is fitted. Each 8-lamp unit includes the latest type of semi-flame lamp in red, white, blue, green and yellow. The manufacturer points out that the set is not confined to Christmas use, but is available for lawn parties, weddings, hallowe'en festivals, and in general for all occasions when fancy illumination is desired.

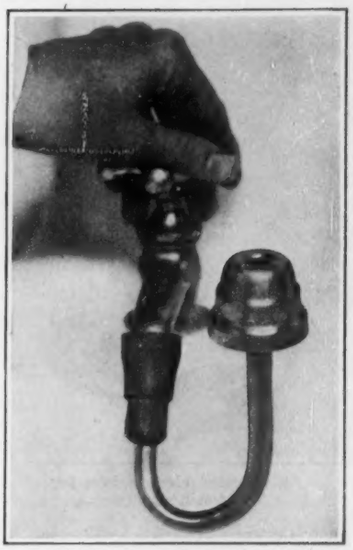
A Drinking Fountain for the Faucet

BY attaching this device to any water faucet in the household a handy drinking fountain can be had. The rubber tubing on the end of the water supply pipe stretches to fit any ordinary-sized faucet pipe. It will not interfere with the supply of cold water for the basin, as it will flow over the mouthpiece into the bowl if desired.—*By M. M. Hunting.*

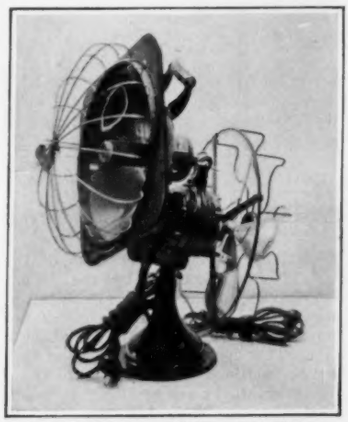
A "Revolutionary" Bicycle Drive

A HUNGARIAN engineer named Jaray announces the invention of a new type of bicycle called the J-wheel. This wheel is constructed on scientific principles and is intended to provide a better vehicle than an ordinary bicycle, for the use of men, women and children.

The ordinary wheel in present use makes use of human muscular power by means of a chain drive sprocket or a bevel gear drive. In this form of drive the forces of rotation which operate at the circumference of the crank drive, even with an impulsive force which remains the same, are not uniform during a revolution. It is possible, of course, according to the well-known principle which operates in machinery construction to compensate in some measure this difference of velocity at the circumference of the drive wheel by a considerable momentum of vibration of the revolving parts in the case of large machines; but since these compensating "working surfaces" are very large in proportion to the amount of work done in the case of a bicycle, it is not possible to obtain a satisfactory degree of uniformity in the case of a light bicycle, except when the latter is moving with great velocity. In these cases, however, in which it is important to extract every ounce of power which is possible from the bicycle, as, for instance, when great resistances need to be overcome, as in the case of bad roads, hills, or contrary winds, the rider frequently finds it impossible to overcome these obstacles since the wheel refuses to operate in the presence of the "crank dead center" created by such resistance. This is why the common bicycle gives poor service in hilly country, etc.



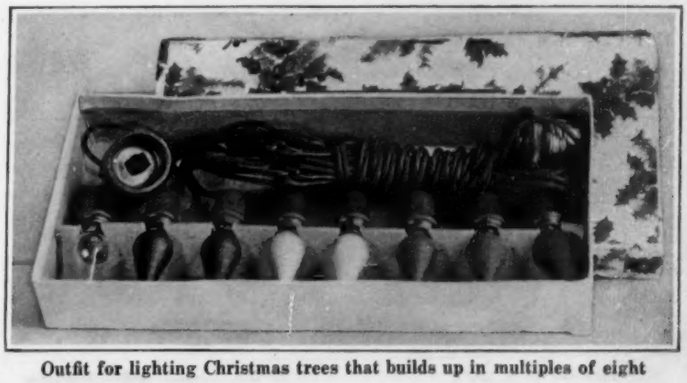
A drinking fountain for the faucet



Electric heater with fan distributor

Jaray has entirely rejected the use of a *crank* and has replaced the latter by a sort of *lever drive*, arranged in such a manner that under the operation of the normal foot power the circumference force upon the rear wheel remains approximately uniform during the entire lift. Consequently, the variation in the velocity remains nil in every case. Furthermore, each of the levels operated by the feet is in a certain measure independent of the other, so that the lift of one can be begun before that of the other has come to an end, thus making it possible to avoid the dead center. The taking up of the foot power of reaction is effected no longer through the weight of the operator or by means of the pull of the driving rod, but by means of a broad back support which is connected with the seat, and by means of this with the framework which makes it possible to exert a two-fold foot power, thus multiplying the weight of the rider. In this manner it is possible to overcome high degrees of resistance which suddenly make their appearance by means of a foot pressure amounting to as much as 150 kg., whereas it is scarcely possible to exert a foot pressure of more than 75 kg. in an ordinary bicycle.

A peculiar advantage of this invention consists in its avoidance of an uneconomic expenditure of power—it pre-



Outfit for lighting Christmas trees that builds up in multiples of eight

An inverted electric iron for pressing coats

vents any excessive friction of the joints, thus preventing the early appearance of fatigue in its driver; furthermore, it eliminates the necessity of a cooperation of the muscles of the arms in order to help out the foot power; it also avoids the lifting of the body for the application of the driver's weight.

Other advantages in this new machine are the absence of a cog wheel, of a chain, of a shaft of self-revolving pedals, while at the same time it possesses three translation stages which bear the ratio to each other of 66:100:136, which can be put in operation without any reversing but merely by a simple shifting of the feet.

Safety and Neatness in Switchboard Panels

THE well-known switchboard panel, with its exposed switches and fuses for controlling a number of circuits in the factory, is fast going out of date. In the first place such a switchboard is dangerous, especially where the voltages exceed 220 volts. Then again, it is not neat and businesslike, and as often as not it is apt to gather dust and moisture which are not conducive to good electric service.

The latest development in electric wiring consists of standardized panels which preserve every desirable electrical and mechanical feature in design and construction that could be secured by the most exacting specifications. Because of regularity in design, precision in manufacture and accuracy in assembly, they are superior to built-to-order boards in many respects.

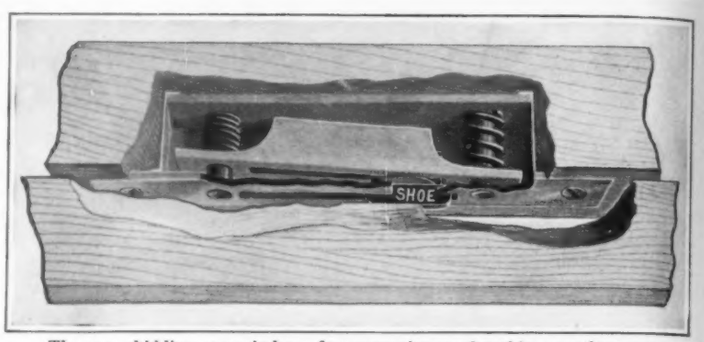
These standardized panels are of molded composition. They look better and are safer than the usual panels because the bus bars are off the front. There is more room on the front for branches and fuse connections. They are easier to connect up and get at, at any time. They cut down labor and material costs in installation. They are always and quickly available, one at a time or in quantities.

An Electric Tailor's Goose

THIS device makes the process of ironing the shoulders of a coat a much simpler one than has been the case in the past. It forms a convenient apparatus for any household. It is really nothing more in its function than an inverted electric iron, for instead of pressing the iron down on the cloth the cloth is rubbed down over the iron.

Street Signs in the Curbing

THERE is always a good deal of difficulty in designing a street sign of any description that shall have equal visibility by day and by night. The illustration herewith shows how San Francisco has attacked the problem. The sign is built into the curbing at the corners. Small holes formed into the name of the street carry the name by day, and lights inside the hollow curb make them equally plain by night. On a street where there is but a single traffic line in each direction this ought to work very well; we have our doubts about its satisfaction on a wide street with two or more lines, one of which would probably conceal the sign from the drivers in the other.



The non-skidding car-window; for convenience of making-up the page it is shown on its side

A Car Window That Will Not Drop

A BATEMENT of the nuisance of the car window which may suddenly and without warning drop on the hand or the arm of an unsuspecting passenger is obtained by the device illustrated herewith, which will effectively retard the downward movement of the sash, thereby preventing damage to the sash frame, glass and sash lock. As indicated in the illustration, the inlaid springs are of different strengths, the heavy one being at the top. In raising the sash the shoe slides to the bottom of its channel and compresses the weaker spring, allowing the sash to be raised with comparative ease, at the same time preventing all rattle. In lowering the sash the shoe automatically slides to the top and compresses the heavy spring, as is shown in the illustration. This increased pressure gives sufficient friction to prevent the sash from falling, and at the same time holds the sash firmly against the outer stops when the window is closed, preventing all rattling.

If preferred, this device can be placed on the edge of the stop casing adjacent to the sash, in which case application is made with the heavy spring at the bottom—since the descending sash here drops the shoe to the lower end of its channel.

The latest night-and-day street-sign consists of colored holes, with lights behind them, in a hollow curb

Primitive Methods of Measuring Distance

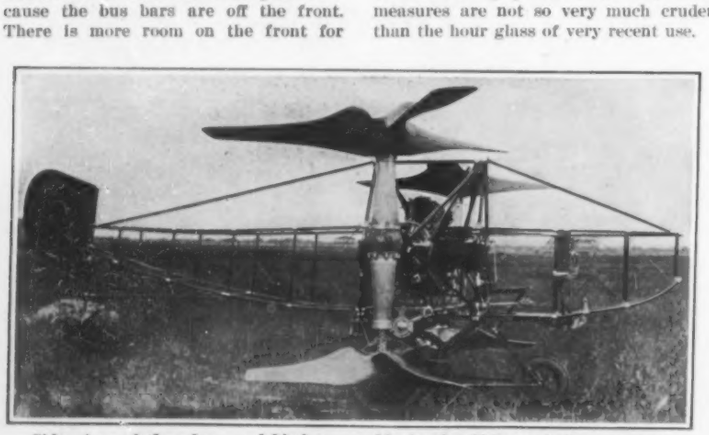
ONE of the curious customs of the Tibetans reported by the Mount Everest Expedition is the measuring of distance by the number of cups of hot tea a man can drink within a definite time. This reminds one, according to a writer in *Die Umschau* (Frankfort), of the observation made by Harry de Windt while traveling in Siberia, that distances were measured by "kettles"—a kettle being equivalent to the length of time required to bring a kettleful of cold water to the boiling point. After all, these measures are not so very much cruder than the hour glass of very recent use.

Helicopter Progress

CHICAGO is the seat of the latest attempt to solve the helicopter problem. Two brothers from the windy city, Leinweber by name, have developed a type of blade which is rather a departure, and which they believe will make machines of the helicopter type practicable.

Tests on the new blade have been made at Armour Institute and at Great Lakes Training Station. The main attempt made is to lift-drive and balance in one unit by propellers. The propeller has been provided with a pitch designed to increase the working of the slower-moving parts to correspond with the faster-working ones. It is hoped in this way to distribute the thrust actively throughout the entire blade, and to drive the air directly away from the propeller in a dense ring coextensive with the propeller blades. A uniform suction of air in front of the propeller throughout the entire blade is also aimed at.

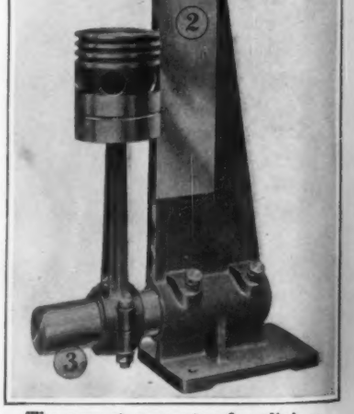
In the tests a machine weighing 1500 pounds was raised from the ground and held stationary in the air for several minutes at a time. The performance of this blade is highly creditable for the present stage of the helicopter art, and lends further emphasis, if any were needed, to the fact, rapidly being realized among aeronautical men, that we may no longer regard the mention of the word "helicopter" as a signal for smiles, laughter, and tapping of foreheads, but we may look forward with confidence to a day when the machine that "goes straight up" will be built.



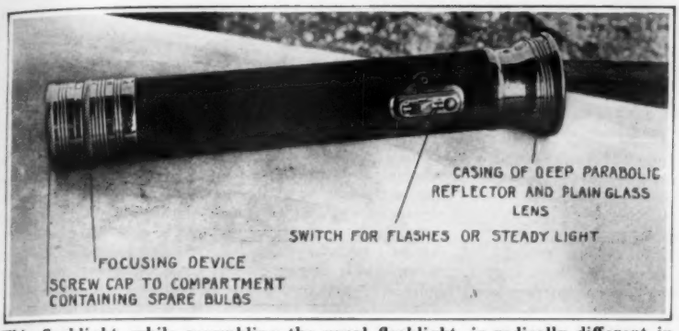
Side view of the plane and blade assembly in the Chicago helicopter tests

Alining Pistons in a Hurry

BY using a device developed by a New York manufacturer it is possible to aline pistons and true up wrist-pins with perfect accuracy. On the arbor of the device connecting rod bearings may be test-fitted in true alinement without the necessity of testing after placing in the car.



The newest apparatus for alining pistons and truing wrist-pins



This flashlight, while resembling the usual flashlight, is radically different in construction and throws a 300-foot beam

Something New in Flashlights

YEAR after year we have been accustomed to using flashlights of the conventional sort, throwing a beam of, say, 50 feet, perhaps 100, if we consider the dim illumination at that distance. It has remained for an American manufacturer, however, to work out a new flashlight which throws a bright beam upwards of 300 feet, and which, for outdoor work at least, puts the flashlight on an entirely new footing.

The secret of this sudden jump from 50 feet to over 300 feet is all in the matter of the filament and the parabolic reflector. In the past, flashlight designers have employed crude reflectors, poorly silvered, and ordinary miniature bulbs, with no attempt whatsoever at focusing the rays. Heavy lenses have been employed, but these have been such crude molded affairs that they aided but little in concentrating the beam.

The present flashlight, which is shown in the above illustration, has no lens of any sort; in fact, a plain piece of glass is used in front of the bulb. However, a special bulb is employed, in which the filament is highly concentrated, while the parabolic reflector has been carefully designed and silvered. A ring at the other end of the flashlight controls the focusing of the beam of light. As this ring is turned, a sleeve moves forward or backward in the flashlight casing and shifts the position of the bulb so that its filament comes to the proper focal point. Thus the beam of light can be spread out for illuminating large, nearby areas, or narrowed down to a pencil-like ray for covering small areas at the maximum distance. Three cells of dry battery are employed, the current being controlled by a simple switch. Two extra bulbs are always at hand in the compartment at the rear of the flashlight.

Selenium Cells That Are Different

HERETOFORE our best selenium cells have come from Europe. We must hasten to explain that selenium cells are devices which change their electrical conductivity according to the amount of light falling on them, and this characteristic has caused their employment for all kinds of service, such is turning on lights and controlling circuits when daylight gives way to night, enabling the blind to read by means of sounds, and so on. But this account has to do solely with the cells themselves.

To Russell Hart of Los Angeles, Calif., goes the credit for having developed what appears to be an improved type of selenium cell. This cell is made by fusing platinum upon a sheet of glass and engraving the electrodes with a suitable tool. The selenium is then applied in an extremely thin layer and crystallized by Mr. Hart's own process on which he has patents pending. The porcelain cup, shown in the illustration, is filled with calcium chloride and sealed over the selenium. This feature makes the cell free from any variation in its operation due to atmospheric conditions. A strip of tinfoil is pasted over each electrode to protect the platinum foil when making contact.

The regular selenium cell has an active surface ½ x ½ inch. In direct sunlight the maximum voltage is 22½ volts when the external circuit has less than 500 ohms resistance, and if over 500 ohms then 45 volts may be used with safety. The full sunlight resistance varies from 10,000 to 20,000 ohms, and the dark values are 1,000,000 to 2,000,000 ohms.

The annoyance of boiling over done away with by this pot

Cannot Boil Over

THE peculiar construction of this cooking vessel makes it impossible for it to boil over or burn the contents. The bottom has a steel jacket which holds the heat long after the gas is turned out. When cooking food comes to the boiling point, water will run up through the perforations, but back through the center hole which is in reality a float.

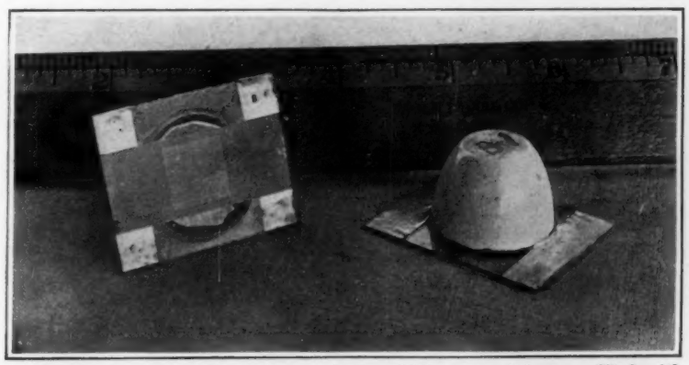
Revolving Directory for the 'Phone User

A CONVENIENT, ready-reference directory for the telephone user is herewith illustrated. It consists of a core of wood, with slits, at intervals, into each of which a folded cardboard may be inserted. On each of these cardboards there is space for half a dozen telephone numbers. Any card may be immediately inserted or removed as desired. The periphery consists of celluloid, amber-tinted. The whole, suspended on a wire support, revolves at the touch of the finger. The device clamps to the telephone stand.

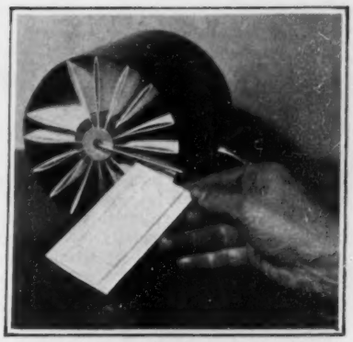
Replacing the Wire That Cuts the Butter

SOMETHING distinctly new and revolutionary has just made its appearance in the butter business, and that is an automatic butter cutter. Heretofore, even with all our vaunted mechanical ingenuity, we have cut print butter by means of wires, operated by men, while the butter was forced out of a forming machine in a steady square rod. This crude manual method, aside from being slow, required considerable help and, because of its lack of accuracy, required a good margin of overweight which mounted into appreciable figures in every working day.

Now comes I. C. Popper, whose various alcohol-burning devices have been described in these columns from time to time, with the automatic butter cutter already referred to. This machine is simplicity itself, and fastens on to any of the usual forming machines. As the butter is forced out of the former in a square rod, it strikes the cutting blades of the cutter wheel. It pushes the wheel around, only to have the following blade come squarely down on it and cut a piece of butter of the requisite size. Still pushing along, another blade is brought down, cutting off another piece of butter, and so on. The blades are so hinged and connected to rollers working over an eccentric cam that they come down with a straight cutting movement, yet turn up out of the way at the desired moment so as not to deform the cut butter. An electric heater at the top of the machine heats the blades as they pass by. The name can be stamped on the prints at the same time, all in one automatic operation.



Two of the new type of selenium cells in which a porcelain cup, filled with calcium chloride, serves to exclude moisture



A revolving director which, being mounted upon a wire support, instantly gives access to its contents

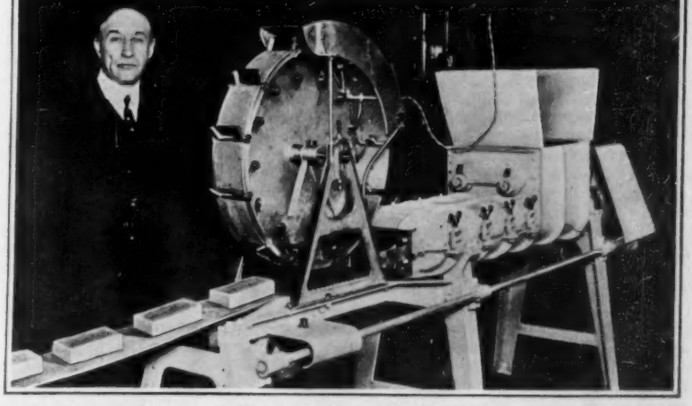
With hand cutters, the best day's run in one plant is reported as 27,500 pounds, using three men and one girl to a machine. With the Popper machine, one plant has averaged 200 pounds per minute, or 960,000 pounds per working day, using only two men. Furthermore, aside from the economy effected, the Popper method is sanitary because hands do not come in contact with the butter. There is nothing to be thrown back into the former, since each cut is accurate. There is a saving in moisture and weight; each print is accurate in weight as the weight can be controlled while the machine is in operation. No extra power is required, as the butter leaving the former is the power, and the faster the butter is fed the faster the prints are cut.

Dirigible Stresses

NO simple but comprehensive method of calculating the principal stresses in the envelope of a non-rigid airship has hitherto been described and published in the English language. Report No. 115 of the National Advisory Committee for Aeronautics describes the theory of the calculations and the methods which are in use in the Bureau of Aeronautics, United States Navy. The principal stresses are due to the gas pressure and the unequal distribution of weight and buoyancy, and the concentrated loads from the car suspension cables.

The second part of the report deals with the variations of tensions in the car suspension cables of any type of airship, with special reference to the rigid type, due to the propeller thrust or the inclination of the airship longitudinally.

A copy of the report may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.



This wheel, equipped with blades, is the automatic butter cutter which speeds up the work of cutting print butter and eliminates considerable labor

The Heavens in February, 1922

Distances and Real Brightnesses of the More Familiar Individual Stars

By Prof. Henry Norris Russell, Ph.D.

AS we look into the heavens on a cloudless night, the stars seem to be scattered over a gigantic vault, and we have no way of telling which is the nearest. We therefore instinctively think of them as though they were all equally far off, and speak of two stars as "near one another" when they seem close together in the sky. It is by no means an easy matter to pass from this superficial appearance to a knowledge of the real distribution of the stars in space, and to tell which are actually our nearer neighbors and which are remote. Yet the question is so often put, regarding the distances of specific ones among the brighter stars, that we may well spend a few moments in considering the answer.

We have several ways of mensuring stellar distances. The most direct is based on just the same principle as that used in the range-finders which are employed with all modern artillery — except that instead of utilizing the small parallax or change in direction of the distant object as seen from the two ends of an instrument a few feet long, we make our "base" stretch across the earth's orbit some 180 million miles.

So accurate are modern photographic observations, that if a star is a million times as far away as the sun a single set of a dozen plates or so will suffice to measure the distance with an error averaging much less than 10 per cent. But if the star is further away than this, the angle of convergence of the lines drawn from opposite ends of the earth's orbit to the star becomes so small that even the minute uncertainties of observation involved in this method become important. Up to a distance of fifty light-years (about three million times the distance of the sun) the direct method is still fairly trustworthy, especially if we can use the average determinations of several good observers; but beyond a hundred light-years it is of little value. The observations, to be sure, inform us that the star is undoubtedly very remote, but do not enable us to say just how remote.

Our Immediate Neighbors

The brightest stars have naturally been the objects of special attention, and we have now good reason to believe that of the 22 stars which are commonly reckoned as of the first magnitude, just about half are within a hundred light-years. Listing these in the order of distance, we must begin with the brilliant southern star Alpha Centauri, which, as veryone knows, is nearer than any other in the heavens. Its distance, 4.3 light-years, is known within two per cent. And from this it follows that, of the two stars which compose the system, the brighter is almost equal to the sun in luminosity, and the fainter one only one-quarter as bright. The faint and remote attendant discovered by Innes two degrees away gives out less than one ten-thousandth of the sun's light, and appears to be nearer extinction than any other body which we can see shining.

Next in order comes Sirius, at a distance of 8.7 light-years—also known within two per cent or better—and a real brightness 26 times as great as the sun's. Only two other stars (both invisible to the naked eye) besides Alpha Centauri are known to be nearer than this. Third on the list is the other dog star, Procyon, distant 11 light-years, and six times as bright as the sun; and fourth is Altair, at a distance of 15 or 16 light-years and giving out nine times the sun's light. These two distances, though not quite so accurately known as the first two, are probably to be trusted to within five or ten per cent.

After this we come to the southern star Fomalhaut. This has not been so carefully observed as the others, and its calculated distance of 23 light-years may be fifteen per cent in error or possibly more. The percentage error of the calculated brightness, 14 times that of the sun, is twice as great. There is little doubt, though, that Fomalhaut is nearer us than the next two stars on our list, Vega and Arcturus. Both have been well observed, and both lie at a distance of thirty light-years or a little more; but their distances are so nearly equal that we cannot say which is the nearer. The real brightness of the two must also be about the same, some sixty times that of the sun in each case.

After these we must place the twin stars of Gemini, Castor and Pollux, which as far as present data indicate are at nearly the same distance, and hence must be fairly close neighbors in space—though their motions are in different directions so that their present proximity will not last long on the cosmical scale of time. Castor has been much more accurately observed and its distance appears to be fixed fairly well at a little over forty light-years, making its two components respectively ten and twenty times as bright as the sun. For Pollux the observations are scantier, and the estimated distance of 35 light-years and 30 times the sun's brightness may be considerably in error.

The next star in order is Capella. Its distance of 54 light-years is fixed very accurately by another method. Spectroscopic observations revealed many years ago that it was a very close double, and Michelsen's interferometer has made it possible to measure the apparent separation of the components, though no telescope yet built can reveal them directly to the eye. The spectroscopic data tell us the distance between the components in miles, and we can then work out the distance of the system from us. The combined light of the two is 200 times that of the sun, so that each component surpasses any of the stars we have yet mentioned. In this particular, however, Aldebaran is probably a close rival. Its distance appears to be between fifty and sixty light-years, and its true brightness about 100 times the sun's—but these numbers may be wrong by twenty per cent.

At 11 o'clock: Feb. 6
At 10½ o'clock: Feb. 14
At 10 o'clock: Feb. 21

At 9 o'clock: Mar. 7
At 8½ o'clock: Mar. 15
At 8 o'clock: Mar. 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

Beyond the Range of Triangulation

Beyond this we enter a region of increasing uncertainty, so far as the direct measures go. Regulus, the brightest star of Leo, should probably follow Aldebaran on the list; but the direct measures of parallax at Yale make the distance 100 light-years, while Adams' spectroscopic method, applied to a seventh magnitude star which is moving with the bright one, and is doubtless at the same distance, give 60 light-years. If we take the average of 80 light-years, we shall do as well as it is possible to do at present. This would make Regulus about 150 times as bright as the sun.

For the more distant stars we have fortunately another string to our bow. Some of them in the southern heavens belong to the great cluster of stars, all moving together, which was discovered by Kapteyn a dozen years ago. The actual rate of motion of the cluster can be found from spectroscopic observations, and then the apparent proper motion of each star gives its distance. Thus it is found that, of the stars of the Southern Cross, Beta Crucis is 190 light-years distant and 700 times as bright as the sun, while Alpha Crucis, 220 light-years away, is composed of two stars, giving out 800 and 500 times the sun's light.

The reader may be impressed by the fact that our stars are getting brighter and brighter, as regards their real luminosity, as we proceed. This is inevitable, for all the stars we are talking about look to be of about the same brightness to the eye, and the remoter ones must of course greatly exceed the nearer ones in real brightness. This may prepare us to learn that of the two remoter stars in Kapteyn's cluster, Beta Centauri is 280 light-years away and 2800 times as bright as the sun; and Antares 350 light-years distant and 3000 times the sun's brightness. The distance here assigned to the last few stars are not likely to be out, on the average, more than 15 per cent.

For the other distant stars we cannot do so well. Two of them are of the Orion type of spectrum, and it is fairly safe to assume that their real motions in space are slow, so the most of their apparent motion arises from the drift of the sun through space. Granting this, the far southern star Achernar (Alpha Eridani) comes out 1000 times as bright as the sun and 120 light-years away; while Spica is 230 light-years distant and gives out 1500 times the sun's light. Betelgeuse—another great star, though very different in color and spectrum, and of far larger diameter—has been well observed and an estimated distance of 200 light-years probably gives a fair idea of the truth, though this may easily be one-third greater or less. The corresponding brightness is 1200 times the sun's.

Last on our list come three tremendous stars, so far away that the direct method of attack is practically hopeless, and so bright in reality that Adams' powerful spectroscopic method gets into trouble because we know no other stars of similar brightness to serve as standards of comparison. For one of the three, Rigel, Kapteyn has made an estimate, based on an exhaustive study of the whole constellation Orion and the neighboring region, which deserves confidence. According to this, Rigel is almost 500 light-years distant and about 13,000 times brighter than the sun. About the other two, Alpha Cygni and Canopus, we know very little. Both have practically no proper motion, and direct measures of parallax give vanishingly small values. In both cases the spectra indicate very great brightness, but it is exceedingly difficult to give numerical values. The best we can say at present is that these two stars are probably as far away as any others on our list except possibly Rigel. Estimating the distance at 500 light-years, we arrive at 6000 times the sun's brightness for Alpha Cygni. Canopus to our eyes far exceeds any other star except Sirius; and if it is 500 light-years away, its real luminosity would reach the amazing figure of 40,000 times that of the sun. These values are mere guesses, yet we have already evidence enough that the statement that the average brightness of Rigel, Alpha Cygni and Canopus is 10,000 times that of the sun, is about as likely to underestimate as to overstate the facts.

The Heavens

Half of the bright stars we have mentioned are visible in our evening sky, and no less than seven of the eleven lie in the southwestern quarter. Castor and Pollux are almost overhead, and Procyon below them in the south. Lower down and a little to the right is Sirius, while Betelgeuse and Rigel are well up in the

(Continued on page 152)

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Engineering in Truck-Tire Building

To the Editor of the SCIENTIFIC AMERICAN:

The article under the above title by Mr. H. W. Slauson in your December issue is brought to my attention, and I am asked to take up some of Mr. Slauson's points which are not in accord with the experience of my company. While he does not say so in so many words, Mr. Slauson's article tells us by inference that there is no general answer to the question—What kind of tires shall we use on our trucks? Our engineering staff heartily concurs in this. But there are several errors of fact and of theory in Mr. Slauson's article. These will be apparent to the tire engineer and to those who have had a scientific training; for the benefit of the layman I wish to record the following corrections:

The 8-inch pneumatic tire is not the normal size for a 2½- to 3-ton truck. When used (as it sometimes is) on a 2½-ton truck it is loaded beyond its rated capacity and fails to give adequate mileage. It is never used on 3-ton trucks. The statement would be correct if written "is normally used on a 1½- to 2½-ton truck."

The idea that the inflation pressure of a pneumatic tire does not increase with increasing loads is erroneous. Tire deflection (flattening at the point of road contact) increases with increasing loads. This deflection causes a reduction in the volume of the air chamber, and since the tire has no appreciable distensibility, the air is naturally further compressed. In his preceding paragraph Mr. Slauson has stated that "the hammer blows struck by the rear wheels as the vehicle passes over depressions or obstructions in the road greatly increases this (inflation) pressure." He then goes on to say that in the very large pneumatics the pressure, or load, on each square inch of surface of road contact will be the same as the inflation pressure per square inch *regardless of the load on the tire.* Here are two conflicting statements, and were the last one true, then a tire inflated with water would be as effective in sustaining and cushioning the load as if filled with compressed air. Also every road obstruction would flatten an air-filled tire to the rim. A tire inflated with water would show no deflection or deformation beyond that possible in the elements going to make up the tire. Increasing loads would have no deforming effect until a point was reached where the tire structure could no longer resist the stress and would burst. Water is incompressible, but air is not.

Mr. Slauson dismisses the pneumatic truck tire from general consideration due to its relatively high first cost. He fails to credit it with increasing the earning power of the truck through increased speed and radius of use. He does not mention the saving in upkeep from better cushioning nor the reduced losses from cargo breakage, nor the reduced fuel and oil consumption. There is as distinct a field for the pneumatic as for the solid. Enthusiasts have retarded the full recognition of its value by recommending it for any and every service, but better judgment now prevails and the pneumatic truck tire is rapidly coming into its own.

"The fact that the rubber of a conventional solid tire has no place to which it may flow when subjected to pressure" is not a fact. It flows out into a "bulge" on the sides. Cushioning qualities rather than resilience are increased by providing additional spaces for the rubber flow. Restriction of this flow increases resilience.

"Replaceable" used in connection with the incompressibility of rubber might better be termed "deformable."

The tractive wave in a solid tire is most destructive in the zone of greatest rubber volume—the center of the tire. Therefore a cushion type of solid tire having central air cavities is more efficient from the standpoint of dissipating this wave and eliminating its destructive effects than the side-notched tire.

The last sentence of the eleventh paragraph would be more scientifically accurate if "stress" were used instead of "strain."

It seems to me that an article of this nature leaves the reader in the wrong frame of mind, particularly if he is a truck owner. Mr. Slauson has established the fact that there are differences in the operating characteristics of the three general types of truck tires, and having thus led the truck owner up to asking the obvious question, does nothing toward advising him which type to use.

New York. E. P. THACHER.

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Slauson's article in your December issue is most interesting. We fully agree with him on many points; we would, however, take issue with him in quite a number of statements he has made.

There is a general answer to the question, "What Kind of Tire Shall We Use on Our Truck?" Furthermore, it is most definite and as decisive as the answer to many questions in the motor as well as the business world. This answer may not be made in an offhand manner.

The motor trucking industry has grown to be a great factor in all branches of industry, including manufacturing, farming, transportation of freight and passengers, etc. No single motor truck could be expected to fulfill the duties of all of the many and varied types of service in which motor transportation is used. Who will deny that there is a general answer to the question "How Shall We Transport Our Merchandise?" However, it is only a matter of good business for the motor truck user to make a careful study of all conditions and factors entering into his transportation of products or merchandise before deciding on the exact type of truck to be used.

This has led to the division of motor trucks under many general heads, such as trucks for delivery, light trucking, heavy trucking, intercity hauling, passenger bus service, etc. There is a general type of truck for any service, but it is not a matter of good business to purchase a truck for any specific service without making a careful study of conditions and design of truck best fitted to the service in question.

The same sort of thing is true of tires. There is a general type of tire for every service, but conditions must be analyzed before a satisfactory decision may be made as to the most practical and economical tire.

We feel that the author's comparison of solid and pneumatic tires is not fair. In the first place, a truck owes its right to existence to the fact that it is a transporter of merchandise. The profit or saving a truck may show depends on the amount of merchandise hauled and the distance it is carried. The former, a most important factor, has been entirely neglected. Best accounting methods take this into consideration. This refutes the statement that "one of the principal objections to the use of pneumatic tires on moderate size trucks is the cost."

Almost anyone will grant the cost of pneumatic tires on light delivery trucks is not excessive. If it were, they would not be so generally used. Let us compare the tire cost of a light truck and moderate size truck in the following manner:

Truck No. 1 hauls ¾-ton load and is equipped with 34 x 5 tires. Truck No. 2 hauls 2-ton load and is equipped with 40 x 8 rear and 36 x 6 front tires. Figuring on present list prices, on a 10,000-mile basis, tubes included and 5 per cent war tax added, the tire cost per ton-mile for truck No. 1 is $0.03544; for truck No. 2 it is $0.02675. The tire cost of the smaller truck is 32 per cent greater.

This is almost a theoretical case, as but very few trucks carry constant pay loads, but it illustrates our point. Much experience has shown that 10,000 miles or more may usually be expected from pneumatic truck tires which are properly used.

Let us now consider the paragraph "Thus the principal advantages of the solid tire are—longer life than the pneumatic; its reliability as far as freedom from blowouts or punctures is concerned; its low initial cost." The first two points, except punctures, which are not very common to truck tires, are wholly dependent on the proper care of the pneumatic tire. We grant that they need to be closely watched; so do grease cups, oil gages and gasoline tanks, if trouble is to be avoided. The lower initial cost means little. The question is, what is the final cost, radius of truck service, maintenance and upkeep and rate of performing a given amount of work. Many other things must also be considered before the conclusion, as to the best type of tire to be used, may be reached.

Different types of tires have a very great bearing on the efficiency and earning capacity of a truck.

Cushion tires are undoubtedly an improvement over the old type of solid tire, but they do not take the place of pneumatic tires. A solid, as it is non-compressible, can not form as efficient a cushion as gas (air), which is highly compressible.

We feel that the author is overly enthusiastic on the subject. It is too new a development to have been thoroughly tried under all conditions. Some very serious faults have already shown up in this type of tire, one of which is very abnormal and premature wear, due to notching the tire to break up the traction wave. The elasticity of the rubber permits a movement of each segment between the notches. This movement is caused by the traction wave, and takes place while the segment is in contact with the road. Rapid wear on one end and normal wear on the other end of the segment results in a very uneven surface. This condition has developed to so great an extent in some cases that the tires had to be removed because of excessive jolting and strains transmitted to the truck.

Akron, Ohio. R. D. ABBOTT.

To the Editor of the SCIENTIFIC AMERICAN:

In an article by H. W. Slauson, M.E., entitled "Engineering in Truck Tire Building," appearing in the December issue of the SCIENTIFIC AMERICAN, certain statements are made in the fourth paragraph, as follows:

"If we consider the larger sizes of truck pneumatics—those which must carry inflation pressures of 140 pounds per square inch—we find an interesting situation. Regardless of the load on the tire, the pressure for each square inch of road surface contact will be 140 pounds, a pressure which may well serve to rut soft asphalt surfaces."

" . . . This is a feature of pneumatic truck tire operation overlooked by many county authorities and highway commissioners in their short-sighted attempts to limit truck loads to an inefficient and absurd maximum. Such highway engineers would not be tempted to permit the use of pneumatic-tired trucks in preference to those of solid or cushion tire if they realized that the pressure per square inch of road contact of the pneumatic-tired truck is the same, regardless of the load carried, and is based entirely on the necessary inflation pressure."

Now, I am not a mechanical engineer; yet the foregoing statements seem so obviously erroneous that, presumptuous as it may appear, I can not resist the temptation of adverting to them.

The pressure on the roadbed depends upon two factors—assuming that the road is perfectly smooth—to wit: the combined weight of the truck and its load; and the area of the tire surface in contact with the roadbed.

That is, the pressure per square inch on the roadbed varies directly with the load and inversely with the area of the tire surface in contact with the roadbed.

The inflation pressure of the tire is merely an internal stress and can not affect the pressure on the road, excepting only to the extent that said inflation pressure is a factor in determining the area of tire surface which, under the force of the loaded truck, comes in contact with the roadbed.

Were it otherwise, or as set forth by Mr. Slauson, then a pneumatic tire with an inflation pressure of 140 pounds would, if removed from the truck and simply laid on the road, exert a pressure of 140 pounds on each square inch of surface contact with the roadbed. EDWARD MAAG.

Prospect, Ohio.

The Breakage of Gage-Glasses

To the Editor of the SCIENTIFIC AMERICAN:

In your first issue of the new monthly an inquiry was made as to why boiler-water gage-glasses break after coming in contact with metal either in cleaning or otherwise.

This is a matter that came to my attention several years ago when I owned one of the early steam automobiles. A pressure of 200 to 250 pounds to the square inch was carried and only the best quality of glasses could be relied upon. It was well known to some of us in those days that one of those glasses could not be cleaned by a swab on a metal rod without causing breakage either at the time or soon after. Breakage would seem to occur spontaneously whether or not the glass was mounted in its fittings. I learned from a source I have now forgotten that the cause of the breakage was the destruction (by a slight scratch from the metal rod) of the surface tension of the tube. This may or may not satisfy your applicant for information, but it seems reasonable that stresses might be set up in the glass while cooling. CHAS. EDW. PRIOR, JR.

Hartford, Conn.

About the Dinosaur

To the Editor of the SCIENTIFIC AMERICAN:

I have just been reading the copy of SCIENTIFIC AMERICAN for August 27th, 1921, and came across a serious scientific error in a short article on page 151 signed by C. M. Lewis, discussing the dinosaur footprints in the Connecticut Valley.

His last paragraph states: "From the position of the tracks on the rock and the skeleton discovered scientists believe that dinosaurs were two-legged and not four-legged animals," etc.

This is entirely erroneous and should be corrected. All vertebrate paleontologists and most geologists are familiar with skeletons of dinosaurs which invariably show small fore legs and long powerful hind legs. The genus Auchisaurus is one of those which inhabited the Connecticut Valley and a skeleton of it has been found with four legs. These dinosaurs usually walked bipedal, but came to rest on all fours when the prints of the small fore feet are clearly shown associated with the much larger hind prints. For further evidence I refer you to Prof. F. W. Loomis of Amherst College, where a fine collection of footprints is on exhibit; Prof. R. S. Lull, of Yale University; Prof. Talbot, of Mt. Holyoke; Prof. H. S. Osborne, of American Museum of Natural History in New York, and, in fact, any department of geology in the larger colleges and universities. It is too bad that such misstatements slip out, and I appreciate that in a paper which handles as diversified subjects as yours it is not always possible to have all the articles checked over by a technically trained man.

WINTHROP P. HAYNES.

Hotel Santa Rita, Tucson, Ariz.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

SUSPENDED TROUSERS PROTECTOR.—E. L. RICHARDSON, 232 Macon St., Brooklyn, N. Y. The invention more particularly relates to waterproof protectors adapted for use in stormy weather to protect the trouser legs from rain which drips from the bottom edge of a coat. A further object is to provide a protector made of yielding material together with a suspension means for holding the same in proper position, whereby the protector will loosely fit about the leg without causing pressure. The device occupies but little space and may be readily carried when not in use.

ADJUSTABLE HAT LINING. — F. GRUNIG and L. VAN HUELE, c/o Pullastic Co., 392 5th Ave., New York, N. Y. The object of the invention is to provide an adjustable lining for women's hats arranged to permit, first, to fit the lining to any size hat, and then fit the hat by means of the lining to any size head. Another object is to provide a lining not liable to leave any marks on the user's forehead even should the hat fit closely or tightly on the head. A further object is to give a smooth, neat finish to the hat.

SOFT COLLAR.—J. W. FISCHER, 181 Schermerhorn St., Brooklyn, N. Y. This invention relates to wearing apparel and its object is to provide a soft turn-down collar arranged to maintain the front of the collar in proper shape without danger of wilting or curling up, thus enhancing the appearance of the collar. Another object is to permit of readily placing the stiffening means in position on the collar or removing the same for convenient laundering of the collar.

INFANT'S GARMENT. — SALLIE W. LAING, Shreveport, La. The object of the invention is to provide an infant's garment combining a baby waist, an abdominal binder and sleeping stockings, and arranged to permit of quickly and conveniently placing the garment in position on the infant to keep the infant warm and protect it against drafts of air, especially at the abdominal region. Another object is to provide means for conveniently attaching a diaper to the garment.

Chemical Processes

METHOD OF AND APPARATUS FOR TREATING AND HANDLING SULFUR.—F. J. HILL, c/o J. R. Jones, Welsh, La. One of the principal objects of this invention is to provide for the treatment and handling of sulfur in the molten condition in which it is delivered from the well, and to render it susceptible of immediate transportation and use. The apparatus consists of a steam-jacketed casing, one end of which is closed, the other open, a conduit for the molten sulfur, and means for breaking up the molten sulfur into small particles and spraying the particles with water to granulate the sulfur. (See Fig. 1, p. 139.)

Electrical Devices

ELECTRIC SIGN.—J. E. LONG, Woodland, Wash. The invention relates to signs of the so-called flashing type. An object is to provide an electric sign which will permit the change from one design to another on the light-board without darkening the light-board. Another object is to provide a pattern sheet having perforations adapted to effect the completion of circuits through the lamps, the sheet being provided with master perforations which are adapted to complete the path for the light circuit, operate a clutch and throw a switch.

ELECTRIC DRIVE FOR VEHICLES.—F. BERGER, 109 E. 15th St., New York, N. Y. Among the objects of the invention is to provide means whereby the power necessary to drive vehicles of any given weight is considerably reduced. Another object is to provide a simple and easily operable control system whereby excess power generated in the power system is stored for future use, and whereby a battery used in conjunction with the power system can be changed at will by the manipulation of a single switch element.

DISPLAY SIGN.—C. F. BOETTCHER, Box 452, North Platte, Neb. The invention relates more particularly to the illuminating means for display signs. An object is to provide a sign having means whereby the number of electric lights necessary to illuminate the sign is reduced to a minimum, the lights being so located that the entire matter to be displayed is uniformly and brilliantly illuminated. The sign is of simple construction, neat in appearance and cheap to manufacture.

Of Interest to Farmers

ROAD DRAG.—J. A. CUTRIDGE and J. A. WOOD, McLoud, Okla. The object of this invention is to provide a device of the character specified of simple and inexpensive construction for grading and rounding up roadways, wherein a scraper plate is provided having means at its ends for connection with draft animals to travel before and behind the plate, said plate having means for permitting either or both ends to be lifted.

TRACTOR PLATFORM.—W. J. BERNARD, Box 154, New Iberia, La. The invention has for its object to provide a device of the character specified adapted for connection with the Fordson type of tractors, for providing a supporting platform on which the operator may stand when he desires, the said platform forming also a connection between the article being drawn and the tractor.

BULL-HOLDING INSTRUMENT.—O. E. HATCH, Box 465, Davenport, Iowa. Among the objects of the invention is to provide an instrument which is adapted to be positioned in the nostrils of the bull, grip the cartilage between the nostrils and hold the bull during the puncturing of the cartilage for the reception of a ring. A further object is to provide an instrument which is so shaped as to form a guide for the passage of a trocar to puncture the cartilage.

BALE FORK.—H. A. WATERMAN, Liberal, Mo. The invention has for its object to provide a fork especially adapted for handling bales of hay, wherein a supporting bar is provided, having means for supporting and permitting the same to be transported, together with a series of impaling hooks for engaging the bales, the hooks being so connected to the bar that they may be simultaneously held in operative position, or tripped to release the bales.

COTTON PICKING APPARATUS.—A. D. ALVIN, address Alvin Mueller Cotton Picker Co., 321 Hicks Bldg., San Antonio, Texas. The purpose of this invention is to provide an apparatus for picking cotton from the plants in the field, in which a pair of picking members are so constructed, supported and operated as to effect a complete removal of the cotton from the plant without collecting any matter foreign to the cotton and without injury to the plants. The device is provided with a wheel-supported chassis and adjustable picking members.

Of General Interest

BLACKBOARD.—C. B. NEIL and R. R. BOGGS, Fannettsburg, Pa. An important object of the invention is to provide a blackboard especially adapted for use in schools, the device being provided with means whereby the board may be raised or lowered to meet the varying conditions encountered during use. For instance, so that a child or teacher may write on the lower portion of the board without inconvenience. The board may be elevated so that the writing may be viewed by the students, and may be held in adjusted position. (See Fig. 2, p. 139.)

HAIR WAVE.—A. SCHARER, 2580 Broadway, New York, N. Y. Among the objects of the invention is to provide a form of hair wave, or rather a pair of coacting hair waves, which will impart that conformation known as the Marcel wave. A further object is to provide a device which is simple and practical in construction and operation, so that women may use the waver at home without the assistance of a professional hairdresser.

REVOLVING HEEL.—T. HAND, 5 West Pine St., Orlando, Fla. The object of the invention is to provide a mounting for revolving heels which can be applied to shoes without requiring the ordinary leather heel, which is capable of application by one inexperienced as a cobbler. The device may be readily changed from one shoe to another, as well as permitting the renewal of the cushion or tread portion of the heel.

SQUEEGEE.—J. F. NELSON, 19 Prentice Ave., Greenfield, Mass. One of the principal objects is to provide a squeegee which is constructed with a flexible elastic strip of rectangular formation so as to expose all the working edges thereof for use, irrespective of the working space in which it is to be used. Another feature resides in the provision of a novel means for associating the resilient strip with its handle, to materially increase its strength and durability.

TOBACCO PIPE.—H. GREGSON, 400 Fulton St., Union Hill, N. J. The invention relates to a pipe which is arranged to prevent burning out of the base of the bowl and thus insuring long life of the pipe. An object is to provide a chamber for the reception of the nicotine to prevent the same from passing into the pipestem and to the mouth of the smoker. A further object is to insure an even draft and a uniform burning of the tobacco.

CLAMPING DEVICE.—P. A. HOFFMAN, c/o Smead Mfg. Co., Hastings, Minn. This invention has particular reference to a device for clamping material such as books or papers together. An object is to provide an automatic clamping device in which the books are constantly subjected to a predetermined pressure between the parts of the clamping device so that their assembled condition is maintained.

HUMIDIFIER.—F. B. SURBECK, 1412 Idaho St., Lewiston, Idaho. Among the objects of the invention is to provide a humidifier which may be used in an ordinary cigar box and which will impart the same amount of moisture to all the cigars in the box, wherein the moist absorbent material used is in direct contact with all the cigars in the box.

WATER METER BOX.—N. FORNI, Santa Rosa, Cal. The invention relates to a protecting box for meters. Its object is to provide a construction which is extremely simple but strong enough to protect a water meter against the pressure of the earth when buried. Another object is to provide a protecting box wherein a removable cover is provided as a cap for the reinforced sides.

FLUSH VALVE.—G. D. SHOWERS, 113 Sixth Ave., Altoona, Pa. The purpose of this invention is to provide a flush valve which is quiet and efficient in operation, durable in service, simple in construction and repair, readily adjusted for timing purposes, automatic, and one which will discharge a predetermined quantity of water at each operation and can be varied by adjustment of the valve.

WINDOW.—C. B. WING, 1233 No. 9th St. W., Cedar Rapids, Iowa. The object is to provide means for connecting a pair of sliding window sashes in such manner that the weight of one sash will counterbalance the weight of the other and thereby permit the sashes to be moved to open or closed position simultaneously. A further object is to provide means whereby the lower sash may be held in substantially raised position, while the upper sash remains in its normal closed position.

METHOD OF MANUFACTURING ORNAMENTATIONS AND FINISHED ARTICLES DERIVED THEREFROM.—G. J. ENGEL; address Engel, Hess & Co., 43 W. 36th St., New York, N. Y. The invention relates to a method of providing an ornament of an extremely fragile and pleasing appearance, particularly adapted for association with wearing apparel, centerpieces, etc., and by means of which each individual element of the ornament will stand out in relief from the adjacent portion, as well as the background.

PLANT STAND.—D. F. LOUDON, 109 W. 102d St., New York, N. Y. The invention aims to provide a plant stand in which primarily the parts may be arranged with respect to each other, to provide a compact unit capable of easy shipment and disposition within a minimum amount of space. A further object is to construct the device with arms capable of being readily adjusted and applied, to accommodate and firmly grip virtually any type or size of receptacle which is to be supported.

ATTACHMENT FOR PENCILS.—A. A. BECK, Puposky, Minn. The invention has in view the provision of an attachment which constitutes the means for associating an eraser with the end of a pencil, pen or other writing or drawing instrument, said means being designed also to function as a clip for retaining the instrument in a pocket. Another object is to provide in combination with a tubular attachment a sliding means for effecting a radial contraction or expansion to grip or release the eraser.

METHOD OF MANUFACTURING TUFTS AND ARTICLES DERIVED THEREFROM.—T. A. BOWERS, 21 Franklin St., Watertown, Mass. The invention aims primarily to provide a method by which the fibers of strands will be firmly fixed in place. A further object is to provide a novel form of binder which will effectively grip upon the strands of fiber of which the finished ornamental device, in the form of a pompon, tuft or tassel, is composed.

PAPER OR BILL FILE.—H. HELFMAN and S. BRAININ, 811 Jennings St., Bronx, New York. The invention relates generally to a file of simple and rugged construction adapted for portable use. An object is to provide a file of such construction that it may be readily made of one piece of metal, either wire or sheet, and so arranged as to present a plurality of spring-like fingers of varying lengths that individual pieces of matter filed may be independently removed.

TRAP NEST.—D. E. COWGILL, Box 159, R. F. D. No. 2, West Newton, Pa. This invention relates to a trap nest provided with a door adapted to be closed by the hen when entering the nest. The general object is to provide a nest of boxlike form having a raised bottom rockably mounted to tilt forwardly and backwardly under the weight of a hen, a swinging door and a lever fulcrumed on the nest and slidably engaging the door to impart a closing movement.

BUILDING BLOCK.—VAN EMERY EASTERDAY, 602 So. Race St., Urbana, Ill. Among the general objects of the invention is to provide a reinforced concrete building block which can be constructed in a simple and inexpensive manner, and which will be light in weight, strong and durable, and by

THE object of this department is to catalog recently patented inventions and design patents for ready reference. In view of the large number of patents covered, it is obvious that each notice must be confined to the broad essentials of the patent described and, in some instances, illustrated. The name and address of the inventor are given in every instance, to facilitate direct correspondence. Copies of the patent specification will be furnished upon receipt of 15 cents each. In a word, this is to be a meeting place for the man with an idea and the business man in search of an idea.

means of which blocks in a wall may be securely locked, in addition to the mortar bond.

ATTACHMENT FOR EYEGLASSES.—L. J. ZIMMERMAN, Ladysmith, Wis. The object of the invention is to provide a device by which a magnifying lens may be quickly and easily attached or detached to a pair of ordinary eyeglasses. It is also an object that the device for carrying and securely attaching the magnifying lenses be simple in construction and inexpensive to manufacture.

HORSESHOE.—W. J. CAHILL, Lincoln Ave. and Baltic St., Jamaica, L. I., N. Y. The aim of the invention is to provide a device of this nature which shall afford ample protection to the hoof of racing horses and at the same time embody good wearing qualities and extreme lightness. A further object is to provide a shoe including a channel member which when filled with a strip of metal, preferably aluminum, will quickly become roughened and will afford a good gripping contact of the surface to be traveled.

RAT TRAP.—T. NAGAYAMA, address Russell and Paterson, Hilo, Territory of Hawaii. An object of the invention is to provide a device which is especially adapted to catch rats and other rodents. A further object is the provision of a trap in which no bait is used, but in its place a sheet of transparent glass with a dark background forming one side of the trap serves to arouse the curiosity of the rat, who will be enticed to enter. The trap is very simple in construction, strong, durable, and practical in use. (See Fig. 3.)

PORTABLE FLOATING BREAKWATER OR BULKHEAD.—M. A. WHITE, 49 Elliott St., Beverly, Mass. The invention relates to marine apparatus or appliances. The prime object is to provide a device adapted to be anchored in a seaway in such a manner that as the seas wash thereover they will be broken up with the result that in the lee of the device the sea will be quiet and calm. A further object is to provide the device with a power plant that it may be moved under its own power from place to place.

REFRIGERATOR.—H. C. PIERCE, c/o Naive Spillers Corp., Nashville, Tenn. An object of the invention is to provide means whereby a circulation of air is induced through an ice or other refrigerant chamber and then through a cooling chamber where poultry, meats, eggs, fruits, vegetables, etc., are stored. A further object is to provide means for controlling the direction of the air, so as to carry off odors and maintain the desired low temperature.

SNOWPLOW.—J. V. MARYLAND, 218 12th St. So., Virginia, Minn. This invention has for its object to provide a device of the character specified adapted to be connected to the front of a motor vehicle and to be operated thereby, wherein mechanism is provided for steering the plow to permit it to follow turns in the road without strain on the plow or the motive power.

BUTTON FASTENER. — N. GUREWITSCH, address A. Livingston, 895 Fairmont Place, Bronx, N. Y. The invention relates to a detachable fastener having a button head provided with a shank to be engaged or disengaged by the fastener means. The general object is to provide a means that will securely hold the button in fastened position and whereby convenience is promoted in the attaching and detaching of the button.

SELF-SERVING STORE.—F. E. JONES, San Diego, Cal. This invention relates to stores wherein the customers wait upon themselves by picking out articles and taking them to the cashier to complete the purchase. An object is to provide a store whereby an inventory of stock may be readily made, and the customer may review the entire stock as he passes along in one direction so that there will be no confusion by meeting others, and so arranged that it is easy for the customers to serve themselves and easy for the stock to be replaced.

PROCESS FOR THE MANUFACTURE OF IRON LEATHER.—O. ROHM, Darmstadt, Germany. Among the objects of the invention is to provide a process for manufacturing iron leather, which consists of subjecting the skins to a tawing solution of iron salts, adding a diluted solution of water glass to the tawing solution, and adding a solution of formaldehyde to the tawing solution.

BAG HANDLE HINGE.—F. C. BOTWRIGHT, 1709 Kater St., Philadelphia, Pa. An object of the invention is to provide an adjustable hinge which can be attached to any type of bag whereby at the will of the person carrying the bag the point of support of the bag with respect to the handle is varied to shift the weight from one side to the other. A further object resides in the provision of means whereby the load of the bag may be so shifted that the bag is automatically held away from the legs.

ATTACHING MEANS FOR SEPARABLE FASTENER ELEMENTS.—A LEVINE and L. OFFERMAN, 334 E. 23rd St., New York, N. Y. The invention relates to means for attaching fastener elements to flexible supports, such as the flaps of briefcases, pocketbooks, music rolls, or similar containers. The primary object is to provide a hasp which carries its own attaching means, which may be quickly and easily attached and will thus be a time and labor saving device.

EDUCATIONAL DEVICE.—E. LE R. MOORE, 4490 Arch St., San Diego, Cal. The object of the invention is to provide a device for teaching children and others number processes, spelling and other facts which may be associated together, as, for instance, the color and its name, a fact of history and its date, wherein the device, being in effect a toy, engages the play instinct while it teaches.

HANDBAG.—M. DIAMOND, 74 5th Ave., New York, N. Y. The primary object of the invention is to so construct a handbag that the same will have a plurality of individual compartments. It is a still further object to so construct the bag that certain of the compartments are accessible without opening the bag, and that when the same is in open position all the compartments are readily accessible.

Hardware and Tools

SOCKET WRENCH.—F. I. SILVA, Box 206, Wailuku, Territory of Hawaii. This invention has for its object to provide a tool especially adapted for use with spark plugs, wherein a series of sockets is provided, any one of which may be brought into use; the wrench comprising a tubular body of polygonal cross-section having its ends of unequal cross-section and having movable sleeves of polygonal cross-section within the ends of the same adapted to be moved into and out of operative position.

LIFTING JACK.—H. M. KNOX, Penokee, Kan. An object of this invention is to provide a jack which is primarily designed for quickly raising the axle of a small automobile off the ground, and a jack in which the weight of the car will operate to maintain the same in elevated position after it has been raised by the jack. A further object is to provide adjusting means which will permit of the jack being used with axles of various heights.

STRAP WRENCH.—W. DUFFORD, 1206 Osage Ave., Bartlesville, Okla. The invention relates to wrenches for turning pipes, bars, or other round objects and more particularly to a wrench employing a flexible strap as the gripping medium, whereby to prevent marring of the work being turned. In such wrenches rosin or its equivalent is used to increase the adhesion of the gripping action, and an object is to constitute the hollow handle of the wrench a container for the rosin.

UPHOLSTERY NAIL.—C. W. TOBEY, Fairhaven, Mass. An object of the invention is to provide a nail particularly designed for upholstery or similar classes of work which will not cut or scar the fabric which it is utilized to secure. A further object is to provide a nail having a slightly resilient solid fiber head, which will obviate the danger of scarring the head when the nail is being driven.

REEL.—S. J. MARTIN, 1114 Irwin St., Woodlawn, Pa. This invention relates to reels especially adapted for use with fence wire or the like. The object is to provide a reel of simple and durable construction and extremely light weight, easy and inexpensive to manufacture and of such compact construction and management as to occupy a minimum amount of space.

PINCHCOCK.—W. S. AVERY, 2200 Highland Ave., Knoxville, Tenn. Among the objects is to provide a device of this type which is formed of a single piece of spring wire bent upon itself, and which may be conveniently manipulated to control the flow of liquid through a piece of tubing. A further object is to provide a tube clamp which will be simple and may be readily applied to a tube to effectively close the same and prevent leakage.

Heating and Lighting

FUEL BURNER.—H. P. PORTER, c/o Gypsy Oil Co., Tulsa, Okla. The invention especially relates to burners adapted for burning gas as a means for heating the water in boilers, though not restricted to such use. An important object is to provide a burner having means for efficiently employing gas under a low pressure, and for preventing back-firing and eliminating much of the noise incident to the use of burners of this type.

FURNACE CASING.—N. FROST, Bloomington, Ill. In general the invention relates to furnaces for heating air to be circulated through rooms in a building, and more especially to the casing for confining the air to be heated, to conserve the heated air, and to prevent leakage or radiation from the casing. Another object is to provide a casing constructed of sheet metal and asbestos or other insulating material made up in panels or sections readily bolted together.

AUTOMOBILE VALVE.—M. J. BARRETT, 82 Prospect Place, Brooklyn, N. Y. More particularly this invention relates to spring-actuated valves for use on gas pipes, which have lever means adapted to permit closing when the pressure of gas falls below a predetermined point. An object is to provide a valve which will automatically close when the pressure of the service pipe falls below a predetermined point. Thus, if the flame should be extinguished by reason of low pressure, there will be no flow of gas should the pressure again rise.

COOKING RETORT.—F. B. DONNELLAN, 106 6th St., San Francisco, Cal. This invention relates to means for inserting cans into and withdrawing them from a retort or cooking vessel in which the contents of the cans are cooked by steam of high pressure, and among the objects is to provide such means which will avoid the loss of steam in such operations.

Machines and Mechanical Devices

REVERSING MECHANISM FOR SHAFTS.—K. R. TELLEFSEN, 73 16th St., Brooklyn, N. Y. This invention has for its general object to provide a reversing mechanism adapted to be associated with drive and driven sections of a shaft, such as a marine engine shaft, whereby to effect with facility either a direct drive between the shaft sections or to bring into play a reversing means for giving reverse movement to the driven shaft section. (See Fig. 4.)

BORING MACHINE.—C. A. SMITH, 180 Canal St., Brattleboro, Vt. An important object of the invention is to provide a boring machine having novel means whereby the vertical and horizontal drills may be simultaneously fed to the work for drilling the hole at different angles into the work. The device is provided with means whereby the pieces to be operated upon are fed to and held in position while being drilled.

DISPENSING DEVICE.—A. E. CARLSON, c/o Nevis Consolidated Schools, Nevis, Minn. The invention is particularly adapted for use in connection with the dispensing of predetermined lengths of paper or towels. An object is to construct a device which shall be adapted to furnish strips of material from a roll, it being unnecessary to provide perforations in the body of the roll to permit of tearing the strip, the device automatically detaching the strip from the body of the roll.

FEED-TABLE FOR PRINTING PRESS.—I. BERKOWITZ, 5 W. 3d St., New York, N. Y. This invention has for its object the provision of a feed-table in which by simple and ready adjustments a wide variety of sizes of paper can be accommodated on one table. The plate is provided with a plurality of grooves in alinement, and adjustable rods which can be moved to positions forming a series of guides for the edges of any desired size of paper.

STEAM FRICTION DEVICE.—F. T. SWANSON, Route 2, Box 391, Hayward, Cal. The invention has particular reference to a device for actuating the clutch on a cable drum or the like. The primary object is to provide a form of device whereby the gripping effect between the cable drum and driving medium therefor may be varied at will and the clutching effect graduated.

TEMPER SCREW.—J. BURNS, c/o Burns Tool Co., Okmulgee, Okla. The invention relates generally to temper screws employed in apparatus for drilling deep wells, its purpose being to lengthen the stroke of the tool step by step as the drilling operation proceeds, so that the bit will be certain to strike the bottom of the hole on each down stroke.

ROPE CONVEYER.—A. DERUNOS, 161 Rue de Courcelle, Paris, France. The invention relates to wire rope systems with fixed cables employed in towing haulage and

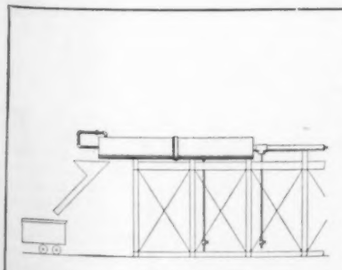


Fig. 1. Apparatus for handling molten sulfur from the well, invented by F. J. Hill

Fig. 2. Blackboard adapted for better display, patented by C. B. Neil and R. R. Boggs

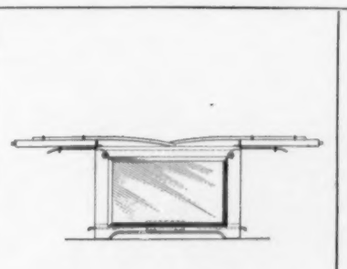


Fig. 3. The baitless rat-trap on which patent has been issued to T. Nagayama

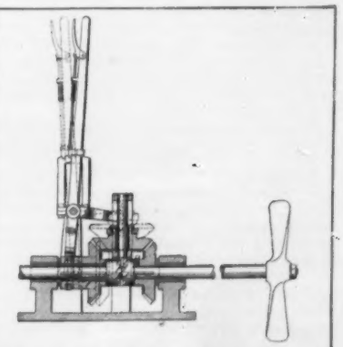


Fig. 4. The reversing mechanism for shafts devised by K. R. Tellefsen

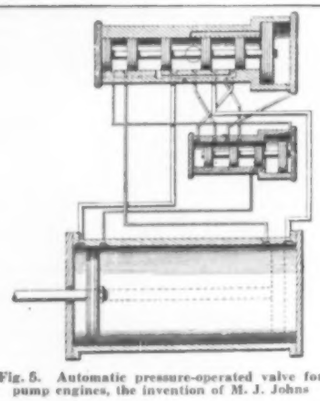


Fig. 5. Automatic pressure-operated valve for pump engines, the invention of M. J. Johns

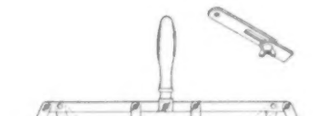


Fig. 6. Tester for automobile engine that facilitates short-circuiting of the spark plugs, singly and in groups; invented by I. Montillijo

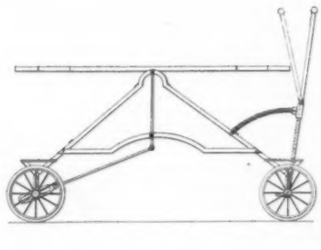


Fig. 7. Combination of toy vehicle and seesaw, devised by T. B. Keogh and L. F. Caumont

transporter plants comprising one or more cables, secured at the ends to anchorage and resting on intermediate supports. Among the objects is to enable the cables to undergo certain longitudinal displacements in relation to their intermediate supports, with the result that the stresses acting on these supports are considerably lessened.

AUTOMATIC PRESSURE OPERATED VALVE FOR ENGINES OF PUMPS.—M. J. Johns, Box 474, Melstone, Mont. The invention relates to valve mechanism for effecting the inlet and exhaust of fluid pressure to and from a cylinder. An important object is to provide a valve assemblage adapted to dispense with all connecting rods or the like between the piston and the sliding valve elements, thereby eliminating the leakage ordinarily incidental to valves as usually arranged. (See Fig. 5.)

DRILLING RIG.—J. J. Thompson, 1758 W. 24th St., Los Angeles, Cal. The drilling rig referred to in this patent has for its object to provide mechanism for use in connection with the reel-controlling lever and on which said lever is mounted, to hold the lever in the desired position without the necessity of any attention on the part of the operator.

COUPLING.—W. J. Drucker, address National Mayonnaise Machine Co., 207 Pacific St., Brooklyn, N. Y. An object of the invention is to provide a simple, inexpensive and durable coupling for connecting a stationary beater, such as are particularly adapted for mixing mayonnaise, to a support so that the stirrer, or beater, may be securely held in position while the receptacle containing the mayonnaise is caused to rotate.

FRONT ROLL STAND FOR SPINNING FRAMES.—D. C. Leonard and A. P. Greer, c/o D. C. Leonard, 94 Morris St., Greenville, S. C. This invention relates to spinning and roving frames of cotton mills. A purpose is to provide a stand having a bearing which is adjustable to support the front feed roller in position to secure the proper tensioning of the yarn, and which is removably associated with the stand to permit substitution of a new bearing when it becomes unduly worn. The mounting of the bearing is such as to permit of both lateral and vertical adjustment.

Musical Devices

PHONOGRAPH CABINET.—J. Bachar, 822 W. 19th St., Chicago, Ill. An object of the invention is to provide a phonograph cabinet in which records are maintained in compartments in the same casing in which the sound-reproducing mechanism is housed. A further object is to provide a device having compartments comprising a series of pockets for individual records, whereby each pocket may be marked so that the record may be quickly located.

Prime Movers and Their Accessories

ENGINE PISTON.—Z. A. Bruegger, 515 No. 9th St., Boise, Idaho. Among the objects of the invention is to provide a lubricating system for internal combustion engines, and particularly a piston construction to effect a predetermined distribution of oil within a cylinder. A purpose is to provide one or more channels on the inner side of the piston which are formed to catch the oil as it is thrown into one side of the cylinder and to deliver the same to the opposite side thereby effecting a proper distribution and preventing uneven wear.

INTERNAL COMBUSTION ENGINE.—E. V. Plush, Turon, Kan. The foremost object of the invention is to provide a carbureter so combined with the engine that use is made of compressed air created by a part of the piston, to convey the fuel to the working chambers, the carbureter including means whereby the stream of compressed air may be either partly or wholly diverted from the spray nozzle, to obtain variously proportioned mixtures.

CARBURETED FUEL SEPARATOR AND FUEL VAPORIZER.—C. F. Smith, 814 W. Mulberry St., Kokomo, Ind. The invention contemplates the use of means in connection with an intake and exhaust manifold whereby to receive and separate fuel flowing from a carbureter to the extent of withdrawing the heavier particles of fluid from the well-broken particles suspended in the air which pass on to the intake ports, the heavier particles so separated falling upon a surface heated by the exhaust gases so as to vaporize the same in order that they may rise into and join the flow of well-broken fuel.

VALVE OPERATING MECHANISM.—F. B. McLean, 138 Broadway, Ocean Grove, N. J. The invention aims more particularly to an apparatus serving to operate valves of internal combustion engines with a view to varying the power of the engine. An object is to provide means for operating the motor with the utmost economy where a relatively small amount of power is required, but when necessary it will be possible to increase the power to such an extent as to develop the maximum efficiency from the motor.

AUXILIARY AIR INTAKE FOR INTERNAL COMBUSTION ENGINES.—J. Bacon, 139 W. 36th St., Los Angeles, Cal. The invention has reference more particularly to an automatically operated auxiliary air intake which is applicable to the intake manifolds of engines between the charge forming device and the engine. It is the purpose of this invention to so construct the device that the engine may be operated with an economical saving of fuel.

ENGINE TESTER.—I. Montillijo, c/o Wm. E. Thompson, 314 San Benito St., Hollister, Cal. The invention relates particularly to a manually manipulated device for use in testing the ignition system of internal combustion engines through the medium of short circuiting the spark plugs. The object is to provide a device which may be manipulated with convenience, which is simple and practical, and at the same time so constructed that it may be used to test engines of various types regardless of the number of cylinders or the relative position of the spark plugs. (See Fig. 6.)

Railways and Their Accessories

STATION INDICATOR.—C. M. Gravatt, 322 Haywood Bldg., Asheville, N. C. An object of the invention is to provide an electrically operated and controlled indicator adapted to be positioned in the end or ends of a car, and which will indicate to the passengers the stations as they are approaching the same, thus relieving the conductor or brakeman of the necessity of calling out the stations and to prevent the misunderstanding of such calls. A further object is to provide means by which all of the indicators in the cars of the train can be simultaneously operated.

RAILROAD TRACK CONSTRUCTION.—P. H. Sampson, 219 N. Buttrick St., Waukegan, Ill. The general object of the invention is to provide a railroad track construction which has means for keeping the two rails equidistant from each other at all times. A further object is to provide means for securing the rails to the ties, and for preventing the nuts on the bolts which hold the sections of rails together from becoming loosened, and to provide means which will require less attention to keep the track construction in order.

SLACK ADJUSTER.—C. F. Kahler, 757 Railway Exchange Bldg., Chicago, Ill. The invention relates to slack adjusters for brakes. An object is to provide an adjuster for railroad cars in which means is provided for automatically maintaining the brake shoes in the required position with respect to the wheels to insure the brakes being applied uniformly to the wheels with minimum travel of the operating parts. A further object is to provide a device which is not liable to get out of order easily.

GRADUATED RELEASE DEVICE FOR AIR BRAKES.—G. A. Anderson, Santa Rita, N. M. The prime object of this invention is to provide a simple and inexpensive arrangement whereby the brakes will be released in a graduated manner proportionate to the increase or building up of train-pipe pressure. A further object is to provide a device which may be readily applied in connection with standard fluid pressure brakes and will be readily accessible for purposes of adjustment or repair.

TRAIN STOP.—G. P. Horan, 12 Madison St., Rutland, Vt. This invention more particularly relates to means for automatically causing the stopping of a train if it attempts to pass a danger signal. A further object is to provide means for opening the air line of the air-brake system of a train, so as to automatically apply the brakes and stop the vehicle if it attempts to pass the signal.

Pertaining to Recreation

TOY VEHICLE.—H. J. Leach, address Howard P. French, Mount Carmel, Ill. Among the objects of the invention is to provide a child's vehicle, more particularly in the nature of an automotive vehicle, including a propelling means, gears, levers, etc., and certain mechanism for varying of speed and rearward movement, conforming in general characteristics at least to the essential operating levers of an actual automotive vehicle.

GAME.—F. H. Anderson, 33 Bell Ave., Paterson, N. J. The invention relates to a game, the primary object of which is to provide a recreation, serving to cause the participants to indulge in physical exercise, and at the same time quickening their faculties. The device consists in providing a number of projectiles and means serving to cause the same to be thrown into the air to be caught by the players.

SEESAW AND TOY VEHICLE.—T. B. Keogh and L. F. Caumont, address L. F. Caumont, 98 3d Ave., New York, N. Y. The invention has for its object the construction of a toy which will act as a vehicle for transporting one or more children, and at the same time acting as an amusement device. Another object is to provide a vehicle with a seesaw or walking beam member arranged to propel the vehicle by the children while riding. The device is so constructed that it may be readily folded into a small space when not in use. The device is illustrated in sectional elevation in Fig. 7.

Pertaining to Vehicles

WAGON BODY.—J. Speed, 123 6th St., Long Island City, N. Y. The invention relates particularly to such bodies as are designed for use in connection with motor trucks for heavy load service and reliable operation. Among the objects is to provide a floor structure for a truck or wagon body having peculiarly strong, reliable and efficient stake supporting means. Another object is to improve the construction of wagon bodies with respect to the combined floor sills and stake supports.

AXLE-MOUNTING.—N. J. Gondolf, 5949 Constance St., New Orleans, La. The invention more particularly relates to a spring-supported wheel, the object being to provide a quick-acting and constantly effective means in connection with wheels, whereby to take up inequalities in the roadway surface for which the ordinary body springs are more or less ineffective. A further object is the provision of means which will assist in absorbing the rebound as well as promote greater life due to decreased wear of the parts.

WHEEL LOCK.—D. J. Raddick, 633 Mission St., San Francisco, Calif. The principal object of the invention is to provide a chock or the like capable of being locked to an automobile wheel to prevent theft, and which is locked to the wheel in such a manner that it can not be manually or otherwise turned around or twisted upon the wheel. Another object is to render the device adjustable so that it may be used on any size wheel. The device is light and neat in appearance and easy to manipulate.

PNEUMATIC TIRE.—C. F. A. Gray, 46 Richmond Square, Montreal, Canada. The invention has particular reference to that type of pneumatic tire cover or shoe wherein an inner carcass or casing is located between the air container and the outer casing, and in which the outer casing is relieved of the greater of the internal strain exerted by the inner tube when inflated. Among the objects is to provide a tire cover or shoe possessing two separate carcasses and an interposed resilient cushion to sustain the inflating force of the inner tube.

REINFORCING PLATE FOR AUTOMOBILE BUMPERS.—H. Bernstein, 306 E. 38th St., New York, N. Y. An object of the invention is to provide a simple and strong device adapted for use with automobile bumpers for the purpose of eliminating the tendency of bumpers to break along those portions which are adapted to be attached to the body or frame of the automobile. Another object is to provide a reinforcing plate to permit the required strength, at the same time permitting a ready adjustment of the bumper.

AUTOMOBILE DOOR LATCH.—D. B. Lauzon, 4048 No. Le Claire, Chicago, Ill. The invention has special reference to a door latch for automobiles, the principal object being to do away with the side motion in pushing the latch to open it, thus permitting the opening of the door with one motion from the outside or the inside of the car. The invention further contemplates a construction which obviates the protruding handle, which necessitates two distinct motions in the opening of the door.

POWER STEERING DEVICE FOR TRACTORS.—O. L. Lewis, 336 W. 65th St., Chicago, Ill. The object of the invention is to dispense with the actual labor

involved in the manual manipulation of the ordinary steering arrangement, which, particularly in large, heavy tractors and upon uneven ground, is fatiguing to the operator. A further object is the provision of a steering device which may be controlled by means of flexible lines from the operator's station either on the tractor itself or upon a trailing vehicle drawn thereby.

MOTOR VEHICLE AXLE.—A. MUENK, 480 24th St., Oakland, Cal. This invention relates generally to axles for motor vehicles but has reference more particularly to a rear axle and mounting therefor which is especially applicable to withstand the hard usage in motor stages, trucks and other such vehicles which carry heavy loads. An object is to supply an anti-friction device in the form of a double row of ball bearings properly confined in a race. (See Fig. 8.)

HEADLIGHT.—E. G. SYLVESTER, c/o Model Sanitary Barber Shop, Honolulu, Territory of Hawaii. This invention has for its object to provide a device of the character specified, especially adapted for motor vehicles, wherein the lamp is so mounted and connected with the body of the vehicle that it may be moved toward or from the vehicle and may be turned with respect to its support to permit the lamp to be adjusted in any position.

THEFT - PREVENTING ATTACHMENT FOR STEERING WHEELS.—E. T. TILDEN, West Concord, Minn. This invention relates to an attachment for preventing the manipulation of the steering wheel and throttle lever of an automobile. It comprises a casing formed of suitable metal and of such a contour as to completely house a steering wheel. The attachment being in semicircular sections, the smaller section may be folded into the larger, with the chain and other parts of the device, for convenient storage when not in use. (See Fig. 9.)

DEADLOCK FOR END DROP-GATES.—C. C. BREAKFIELD, c/o Jesse B. Boyd, Allensville, Ky. The object of the invention is to provide a simple, inexpensive and easily operated lock which will hold the end gate in closed position without danger of accidental release, and which may be easily released when desired to permit the gate to drop into open position. A further object is to provide a folding rack which may be used with an ordinary bed of a wagon body.

SHOCK-ABSORBER FOR AUTOMOBILES.—F. SACKETT, 3511 Genesee St., Kansas City, Mo. Among the objects of the invention is to provide a shock-absorber which can be applied to an automobile of a well-known type without any changes to the latter and without the use of special tools. A further object is to provide means for preventing "side sway" of the body of the vehicle and for resiliently dissipating the shocks and jars and checking the rebound without impairing the efficiency of the springs ordinarily installed.

DOOR FOR AUTOMOBILES.—J. J. MCGUIRE, 21 Sherman Ave., Yonkers, N. Y. An object is to provide a door of the glass panel extension or window type, arranged to permit of folding the window within the door whenever it is desired to convert the automobile body from an open to a closed one, and to allow of raising or lowering the window to suit the occupant. Another object is to provide a window that is self-contained in the door and is adapted to be moved in guideways forming part of the door itself.

AUTOMOBILE LOCK.—S. B. CLAYTON, 432 Church St., Greensboro, N. C. The invention relates to locking devices for preventing the surreptitious use of automobiles. A purpose is the provision of a locking device which is adapted to lock the steering gear in such manner that upon unauthorized movement the vehicle will be caused to travel in an unchangeable direction. The device is simple, inexpensive and adapted to steering gears of the standard construction.

SPRING WHEEL.—A. F. MCGRATH, 381 E. 160th St., New York, N. Y. The general object of the invention is to provide a wheel of the indicated type improved in various particulars with respect to the arrangement and form of the resilient spokes and springs, whereby to provide for yielding of the wheel rim relatively to the hub portion. The device is characterized by strength and simplicity as well as convenience of assemblage.

DIRECTION INDICATOR. — E. F. KIESSLIN, P. O. Box 557, Oakland, Calif. The object of this invention is to provide a direction indicator of the semaphore type for use on motor vehicles. The device may be mounted upon the vehicle and manipulated by an occupant, preferably the driver, for conveniently indicating an execution of a right or left hand turn or stop. The primary object is to provide an indicator which will comply with the universal signal regulations.

DIRIGIBLE HEADLIGHT.—G. W. J. CRABB and E. J. RENNIE, 16 Munn Ave., Orange, N. J. One of the principal objects of this invention is to provide means for dirigibly associating a headlight with a vehicle in such a way as to reduce the vibration of the headlight to a minimum. Another object is the provision of means by which the headlights are turned an equal degree in order to maintain the concentration of the rays. The lights may be adjusted so as to be applicable to vehicles of various sizes.

SPRING MOUNT FOR VEHICLES.—H. B. BACON, 418½ 3rd St., Virginia, Minn. An object of the invention is to provide a spring mount having means for obtaining a maximum resiliency with a minimum oscillatory movement of the frame of the vehicle to which applied relative to the axles of the same. A further object is to provide a device designed to operatively connect the side frame members of the vehicle with the axles without the necessity of making extensive changes in the construction of the vehicle.

ORE CAR.—A. ROY, Box 222, R. F. D. No. 2, Huntington, N. Y. The invention aims to provide a car of this nature, the body of which is hinged in connection with its truck and is provided with a normally upstanding shovel extension at its front end so that when the body is tilted to vertical position the shovel and the body act as a scoop in order to provide for self-filling of the car by simply forcing its shovel extension into an ore pile.

Fig. 8. Rear axle for automotive vehicle designed by its inventor, A. Muenk, to better withstand frictional wear

FOUR-WHEEL DRIVE.—R. D. SMITH and A. CHRISTOPHERSON, c/o G. O. McMenimey, Craigmont, Idaho. The primary object is to provide a simple four-wheel drive structure by which, in addition to furnishing traction through the rear wheels, the front wheels may also be used for driving purposes, as well as steering purposes, and will allow the necessary rocking and swinging or turning movements to compensate for unevenness in the road surfaces, while the driving parts are so constructed and arranged as to be driven from a common motor.

AUTO ATTACHMENT.—F. C. MILES, 2017½ J St., Sacramento, Calif. The invention relates more particularly to Ford automobiles. Its object is to provide a bearing means for the rear axle housing of the same. A further object is to take the weight of the housing from the axle altogether and have it supported by the wheel through the medium of the brake-drum, so that the only work to be done by the axle is that of rotating the wheel. This special attachment replaces the roller bearing and roller bearing sleeve found between the axle and its housing in Ford cars as now constructed.

SWITCH.—A. H. PERRY, DeWitt, Ark. The invention relates to a device for use on automobiles whereby to control the ignition circuit by the angle assumed by the vehicle in ascending or descending unusual grades. Among the objects is to provide means whereby the movement by gravity of a suitable graded device may operate to control the ignition circuit. A further object is to provide a device which may be adjusted to operate whenever the vehicle may assume any predetermined angle.

ROTARY JACK FOR VEHICLES.—F. B. URBANO, 16 E. 47th St., New York, N. Y. The general object of the invention is to provide a rotary jack for use in connection with automobile wheels to be applied over the tire casing to constitute applied tread and having an eccentrically disposed auxiliary tread to act as a jack, whereby the device, in addition to its usefulness as a jack, may function as an ordinary tread when applied over the casing of a deflated tire that the vehicle may run without damaging the same.

VEHICLE DRIVE—E. S. MILLER, Massillon, Ohio. An object of the invention is to provide a vehicle with a propelling means consisting of an endless belt mounted upon pulleys and driven by one or more of said pulleys, said belt contacting with the outer surface or periphery of the wheel and causing the wheel to be turned by the frictional engagement of the belt therewith. A further object is to provide a vehicle wheel consisting of a pneumatic ball or spherical member comprising a pneumatic cushion and operated by contact of an endless belt.

Designs

DESIGN FOR A HAIR FRINGE.—M. MULLER, address Wm. Kaufman, 1482 Broadway, New York, N. Y.

DESIGN FOR AN AUTOMOBILE.—J. M. KAWANAMI, 8 Shima Tract, c/o C. M. B. Co., Stockton, Calif.

DESIGNS FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y. The inventor has been granted patents on twelve ornamental designs for powder containers, comprising upper bodies of circular, oval, or elliptical formation, and lower bodies, triangular, oval, sector-shape, or square.

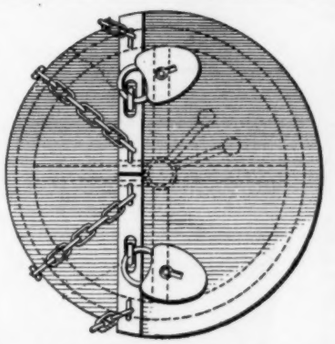


Fig. 9. Theft-preventive attachment for the steering wheel, the invention of E. T. Tilden

DESIGN FOR A DOLL.—RUTH H. USHER, 44 Hanson Place, Brooklyn, N. Y.

DESIGN FOR A POWDER-CONTAINER OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y.

DESIGN FOR A TEXTILE FABRIC.—W. W. MAYER, 104 Walker St., New York, N. Y.

DESIGN FOR A HANDLE FOR TRAYS OR SIMILAR ARTICLES.—A. BARCHOFF, c/o Eastern Metal Spinning Co., 467 Greenwich St., New York, N. Y.

DESIGN FOR A STONE SETTING.—A. FRANK, 88 Nassau St., New York, N. Y.

DESIGN FOR A RIBBON CLASP.—S. BRUNER, 64 Fulton St., New York, N. Y.

Miscellaneous Notes

Cat-Skins for Faceache.—Cat-skins have long been sold by French pharmacies as a sovereign remedy for faceache, and puss brings a much higher price since the war.

Pushball Played with Fire Hose.—At a British carnival in aid of a local hospital a new variation of pushball was greatly enjoyed. Opposing teams of firemen directed streams of water against the ball. It is to be hoped that the spectators wore waterproof clothing.

For Better Packing.—Last November was "Perfect Package Month," during which railroads, steamship lines and express companies united in an attempt to impress upon the shipping public the need for good packing and the way in which it would improve the transportation service of the country.

The Passing of the Moat.—The ancient moat, though picturesque, breeds disease. The big ditch around the Tower of London has long been drained; now the Bishop of London has filled up the moat at Fulham Palace, arousing the indignation of the Society for the Protection of Ancient Buildings.

Heligoland's Transformation.—When a syndicate of American and German capitalists finish waving the magic wand over Heligoland, the former grim wasps' nest will assume the aspect of a most attractive bathing resort, with a winter hotel, and a casino offering every facility for polite gambling. It is intended that Monte Carlo shall feel the competition.

Friends in London.—The stranger in London may now go to any one of 750 friends for comfort and advice. The General Omnibus Company has stationed an inspector at each important traffic center, who is especially trained to give any information regarding the way to get about the city. Look for the dark blue serge uniform and the cap badge with the initials "L. G. O. C."

On the Track of Treasure-Trove.—An old parchment in Italian has been found at Bisceglie, in the Province of Bari, Italy, telling of buried treasure supposed to have been hidden by a Roman matron at the approach of Hannibal's troops in 216 B.C. The treasure is particularized as consisting of 170 costly vases filled with gold and silver coins, antique works of art, jewels and pearls. The engraved stone indicating the place of concealment is said already to have been found.

An International Language.—Our representatives before the International Research Council in 1919 urged the desirability of publishing an international abstract journal of chemical literature. Language was the stumbling-block. A committee of investigation recently reported to the British Association. They had considered three types: (1) A dead language, as Latin; (2) A national language, as English; (3) An invented language, like Ido or Esperanto. Their conclusions were that Latin is too difficult; that the adoption of any national language would confer undue advantages and excite jealousy; and that therefore an invented language would be best.

Historic Trees.—Among trees recently nominated for the Hall of Fame for Trees by the American Forestry Association is the "Witness Tree" of the Donegal Presbyterian Church, in Pennsylvania. Its history is known for the past 200 years. Two others are an oak and a willow associated with George Washington, the first on the Hampton plantation, South Carolina, where Washington visited and admired it, the second at Constantine, Mich., grown from cuttings from the large weeping willow over the tomb at Mount Vernon. Another nomination is the Lewis Cass elm at Elyria, Ohio. This is probably the oldest, for it has stood for at least 250 years.

Foreign Commercial Laws.—The Department of Commerce is compiling a comprehensive survey of commercial laws in foreign countries. Some years ago a partial investigation of a similar nature resulted in the publication of a few monographs dealing with certain countries. The present plan goes far beyond this, and will have a topical arrangement. The subdivisions are: (1) General laws on the conduct of business; (2) Agency laws; (3) Sales contracts; (4) Bankruptcy laws and practice; (5) Bills of exchange; and (6) Commercial litigation, court procedure, etc. Far from having the object of eliminating the lawyer it will, on the contrary, place valuable data at his disposal, enabling him to serve his clients with greater efficiency.

Timken Bearings

Abbott & Downing
Models A, AX
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models B, BX
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Acason
Models R 1t, R 1½t
Rear Wheels
Worm Shaft
Differential
Models H 2t, L 3½t, M 5t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Ace
Models 1 ½ t., 2½t
Front Wheels
Rear Wheels
Worm Shaft
Differential

Acme
Models G ¾t, B 1t, F 1½t, A 2t., AC 2½t, C 3½t, E 5t
Front Wheels
Rear Wheels
Worm Shaft
Differential

Ahrens-Fox
Models J, K, L, M, N, P
Front Wheels
Rear Wheels
Steering Pivot

Ajax
Model 1t
Front Wheels
Rear Wheels
Worm Shaft
Differential

All-American
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Ambassador
All Models
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential

American La France
All Models
Front Wheels
Rear Wheels

Apex
Model E
Front Wheels
Pinion Shaft
Differential
Models D, G
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Apperson
All Models
Front Wheels
Rear Wheels
Transmission
Pinion Shaft

Armleder
Model 20 1t
Front Wheels
Rear Wheels
Worm Shaft
Differential
Models HW 2 ½ t, KW 3½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Atlas
Model 21
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Atterbury
Model 20-R 1½t
Front Wheels
Rear Wheels
Worm Shaft
Differential
Models 7 C X 2½t, 7 D X 3½t, 8E 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Auburn
All Models
Front Wheels
Differential

Autocar
Models XXI F and G
Front Wheels
Rear Wheels
Pinion Shaft
Transmission
Differential
Jack Shaft
Models XXVI-I and B
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Jack Shaft
Model 2t
Rear Wheels
Pinion Shaft
Differential
Reduct'n Shaft

Available
Models H 2½t, H 3½t, H 5t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Avery
Rear Wheels
Pinion Shaft
Differential

Bock
All Models
Front Wheels

Beggs
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Bessemer
Model G 1t
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models H-2 1½t, I-2 2½t, K-2 4½t
Front Wheels
Transmission
Pinion Shaft
Differential

Bethlehem
Model 1½t
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models 2½t and 3½t
Pinion Shaft
Differential

Big 4
All Models
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Bour-Davis
All Models
Front Wheels
Differential

Brewster
Model O2
Front Wheels
Rear Wheels

Brinton
Model F
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Brockway
Model S-4 1½t
Transmission
Models K-5 2 ½ t, R-4 3 ½ t, T-4 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Buick
All Models
Differential

Cadillac
Type 61
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Case
Truck
Front Wheels
Pinion Shaft
Differential

Chandler
All Models
Front Wheels
Pinion Shaft
Differential

Chevrolet
Model 490
Front Wheels
Model 1t
Front Wheels

Chicago
Models C 1½t, C 2½ t., C 3½t, D 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Cleveland
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Clydesdale
Model 42 1½t
Front Wheels
Rear Wheels
Worm Shaft
Differential
Models 18, 20, 65, 90, 120
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Collier
Models 19, 22
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Columbia
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Columbia Truck
Models F, G
Front Wheels

Commerce
All Models
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Commercial
Models BR-1, BR-2, BR-4, AK-7, AK-10
Front Wheels
Rear Wheels

Corbitt
Models A, B, C, D, E
Transmission

Crawford
Model 22-6-40
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Crow-Elkhart
All Models
Front Wheels
Rear Wheels

Cunningham
All Models
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential

Daniels
Model D-19
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Dart
Model M 2½t
Rear Wheels

Defiance
Model D 1½t
Rear Wheels
Pinion Shaft
Differential
Model E 2t
Pinion Shaft
Differential

Denby
Models 33, 134
Front Wheels
Model 25
Front Wheels
Steering Pivot

Dixie Flyer
All Models
Front Wheels
Rear Wheels

Doane
Model 3½t
Transmission
Models 2½t, 6t
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Durt
17 Series
Front Wheels
Pinion Shaft

Driggs
All Models
Front Wheels
Rear Wheels
Differential

Duesenberg
All Models
Transmission

Durant
Model 4-Cyl.
Front Wheels

Essex
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Eugol
Speed Trucks
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Fageol
Model 1½t
Transmission

Ford
All Models
Front Wheels

Forster
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Fox
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Fulton
All Models
Front Wheels

Gardner
Model G
Front Wheels
Pinion Shaft

Garford
Model 150-A
Front Wheels
Rear Wheels
Model 25-B
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models 15, 68-D, 70-H and 77-D
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Gary
Models F 1t, I 1½ t, J 2½t, Motor Bus, Farm Special, K 3½t, M 5t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

G M C
Models K-41, K-71, K-101
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Giant
Models 15, 16 and 17
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Graham
Model 1t
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Hahn
Models 1t, 1½t, 2t, 2½t, 3½t and 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Hall
Models 1½t, 2t, 3½t, 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Hal-Fur
Models B, C
Front Wheels
Rear Wheels
Transmission
Steering Pivot
Worm Shaft
Differential
Model D
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Handley-Knight
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Hanson
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Hendrickson
Models O 1½t, N 2½t, M 3½t, K 5t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Holmes
All Models
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential

Hudson
Super-Six
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Huffman
Model 1t
Rear Wheels
Pinion Shaft
Differential

Hupmobile
All Models
Front Wheels

Independent
All Models
Front Wheels

Indiana
All Models
Transmission

International
Model S ¾t
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models 1t, 2t, 3t, 5t
Front Wheels
Transmission

Jackson
Models 21-4 and 6-38
Front Wheels
Rear Wheels
Differential

Jordan
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Jumbo
Models 25, 30
Front Wheels
Model 35
Transmission

Kalamazoo
Models G-1 and G-2
Front Wheels

Kelsey
All Models
Rear Wheels

Kelly-Springfield
Model K-31
Front Wheels
Rear Wheels
Models K-32, K-34
Front Wheels
Rear Wheels
Worm Shaft
Differential
Model K-35
Front Wheels
Rear Wheels
Steering Pivot
Models K-36, K-38
Front Wheels
Steering Pivot
Worm Shaft
Differential
Models K-40, K-45, K-50, K-60
Front Wheels
Rear Wheels
Differential
Sprocket Shaft

King-Zeitler
Models 1½t, 2t, and 2½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Kissel
Custom Built 6
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Freighter
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Kleiber
Models ¾t, 1t, 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models 2t, 2½t, 3½t, 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Koehler
Model D 1½t
Front Wheels
Model M 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Lafayette
Model 134
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Lansden
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Sprocket Shaft

Larrabee
Models K, L, U
Transmission
Model X-2
Transmission
Differential

Leach
All Models
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Liberty
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Lincoln
All Models
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

TIMKEN
Tapered
ROLLER BEARINGS

Differential
Model W 3½t
Transmission

Davis
Models 61, 62, 63, 64, 65, 66, 67
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Day-Elder
Model F 3½t, E 5t
Transmission

De Martini
All Models
Transmission

Dependable
Models C 1½t, E 2½t
Front Wheels

Detroit Electric
All Models
Front Wheels
Rear Wheels

Diamond T
All Models
Front Wheels
Rear Wheels

Dodge Brothers
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Durris
Model 6-80 Passenger
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models K-4 2t, K-7 3½t
Front Wheels
Rear Wheels

Rear Wheels
Model 6-Cyl.
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Earl
All Models
Front Wheels

Elcar
All Models
Front Wheels
Rear Wheels
Differential

Model 2t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models 3½t, 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Federal
Models 1t, 1½t, 2t, 5t
Front Wheels

—Where and Why

L M C
Model 2½t
Front Wheels

Locomobile
Model N-48
Front Wheels
Steering Pivot
Models B-2, BB-2
Front Wheels
Rear Wheels
Steering Pivot

Loedinghaus
Models It, 1½t, 2t, 2½t
Front Wheels

Luverne
Model Express
Rear Wheels
Pinion Shaft
Differential

Maccar
Models G, H, H-2, M-2
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Models L, L-2
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

MacDonald
Model A
Front Wheels
Rear Wheels
Differential
Model B
Front Wheels
Rear Wheels
Worm Shaft
Differential
Sprocket Shaft

Mack
Models 1½t, 2t, A-B Worm; 1½t, 2t, A-B chain; 1½t, 2t, 2½t A-B Dual R; 3½t, 5t, 6t, 7½t A-C chain
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential
Motor Shaft

Maibohm
Model B
Front Wheels
Rear Wheels

Marmon
All Models
Front Wheels
Steering Pivot

Master
Models A, AL, B, BL
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Models JW, W, and WL
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Maxwell
Model 1t Tr.
Front Wheels
Rear Wheels
Pinion Shaft

McFarlan
All Models
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Menominee
Models D, H, HT
Front Wheels
Models G, J 3
Front Wheels
Rear Wheels
Worm Shaft
Differential

Metz
All Models
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Mitchell
All Models
Front Wheels
Rear Wheels

Moon
Models 6-48 and 6-68
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Moreland
Model 1½t
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models 2½t, 3½, 5t
Pinion Shaft
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Napoleon
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Nash
Model 2t Quad
Front Wheels
Rear Wheels
Worm Shaft
Differential

National
Model BB
Transmission

Nelson & LeMoon
Model G 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models G 2½t, G 3½t, G 5t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Netco
Models 2t, 2½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

New York
Model 2t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Niles
Model 2t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Noma
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Ogden
All Models
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Old Reliable
Model L 7t
Transmission
Rear Wheels

Oldsmobile
Passenger Car
Differential
Models ¾t and 1t Tr
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Oneida
Model E-9 5t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential
2t Electric
Front Wheels

Oshkosh
All Models
Transmission

Overland
Model 4
Front Wheels
Differential

Packard
Single 6, Pass.
Front Wheels
Pinion Shaft
Differential
Twin 6, Pass.
Front Wheels
Models 2t, 3t, 5t, 6t Tr
Front Wheels
Rear Wheels

Paige
Model 6-44 Pass.
Front Wheels
Differential
Model 6-66 Pass.
Differential
Model 54-20 2½t
Transmission
Model 51-18 3½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Model 52-19 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Pan American
All Models
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Parker
Model E 1t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models F-20 2½t, J-20 3½t, and M-20 5t
Front Wheels
Rear Wheels
Worm Shaft
Differential

Peerless
All Models
Front Wheels
Pinion Shaft
Differential

Piedmont
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Pierce-Arrow
Models 32, 33,
Front Wheels
Rear Wheels
Models 2t and 5t Tr
Front Wheels
Rear Wheels

Premier
All Models
Rear Wheels
Front Wheels
Steering Pivot
Pinion Shaft
Differential

Premocar
Model 6-40
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Quaker City
Taxicab Models
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Republic
Model 75 ¾t
Front Wheels
Models 10, 10 E 1t
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Models 11-X 1½t, 19 2½t
Front Wheels
Pinion Shaft
Differential
Model 20 3½t
Pinion Shaft
Differential

R & V Knight
Model J
Front Wheels
Rear Wheels
Steering Pivot
Pinion Shaft
Differential

Rowe
All Models
Transmission

Ruggles
All Models
Transmission

Sandow
Model Taxicab
Front Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Saxon Duplex
All Models
Front Wheels

Sayers
Model T
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Model S
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Selden
Model A 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models A 2½t, A 3½t, A 5t,
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Seneca
All Models
Front Wheels
Rear Wheels

Service
All Models
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Signal
Models J, M and R
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Models H, NF
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Singer
All Models
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Standard Truck
Models 76 2½t, 66 3½t,
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Model K 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Stephens
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Sterling
Model 1½t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential
Models 2t, 2½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential
Models 3½t, 5t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential
Models 5t Ch., 7½t Ch.
Front Wheels
Rear Wheels

Stoughton
All Models
Transmission
Propeller Shaft

Studebaker
Light Six
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential
Special Six
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential
Big Six
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential

Sullivan
Models E 2t, H 2½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Superior
Models 1t, 2t
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Three Point
Models 3t, 6t
Front Wheels
Rear Wheels
Transmission
Worm Shaft
Differential

Titan
All Models
Front Wheels

Tower
All Models
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Traffic
Model C
Front Wheels

Transport
Models 70
Front Wheels

Traylor
Model E
Transmission

Twin City
Model BW
Front Wheels
Model AW
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

U S
Models N, NW
Front Wheels
Models R, S and T
Transmission

Velie
Models 48, 58
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Victor
Model 2t
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Walker Johnson
Models A, 2t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Walker
All Models
Front Wheels
Steering Pivot

Ward La France
Models 2½t, 3t, 3½t, 5t, 6t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Ward Electric
Model WS
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Westcott
Model C-38
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Model C-48
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Pinion Shaft
Differential

White Hickory
Models E, H
Front Wheels
Rear Wheels
Worm Shaft
Differential
Model K
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Willys-Knight
Model 20
Front Wheels
Steering Pivot
Pinion Shaft
Differential

Wilson
All Models
Front Wheels
Rear Wheels
Steering Pivot
Worm Shaft
Differential

Winther
Model 49
Front Wheels
Transmission
Models 70, 109 and 140
Front Wheels
Steering Pivot
Transmission
Models 61, 751
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Winton
Model 25
Front Wheels
Rear Wheels
Transmission
Pinion Shaft
Differential

Witt-Will
Models N 1t, N 1½t, P 2t, P 2½t
Front Wheels
Rear Wheels
Steering Pivot
Transmission
Worm Shaft
Differential

Wolverine
All Models
Front Wheels
Rear Wheels

Yellow Cab
Taxicabs
Front Wheels
Rear Wheels
Pinion Shaft
Differential
Trucks
Front Wheels
Rear Wheels
Worm Shaft
Differential

Reliance
All Models
Front Wheels
Rear Wheels
Worm Shaft
Differential

Reo
Passenger Car
Front Wheels
Pinion Shaft
Differential
Speed Wagon
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Revere
All Models
Transmission

Rickenbacker
All Models
Transmission

Roamer
All Models
Front Wheels
Rear Wheels
Pinion Shaft
Differential

Schacht
All Models
Front Wheels
Rear Wheels

Schwartz
Highway Exp.
Front Wheels

Seagrave
All Models
Front Wheels

A motor vehicle can be no better than its *vital*—its inside—parts

Where you cannot see—*inside* the wheels, *inside* the transmission, *inside* the rear axle—the very vitals of your machine—you must be certain you have the best protection

The manufacturers' deliberate installation of Timken Tapered Roller Bearings, the dealers' eager acceptance of them, the owners' unprecedented satisfaction, show an universal pride in Timken Bearings because they

—carry all loads;
radial (up-down), thrust (side-end), resultant (combination)

—at all speeds;
often, in transmission and on pinions as high as 3,000 r p m

—in simple mountings;
with fewer parts, appreciably less weight, greater accessibility

—with rare attention;
your Path of Power is best protected against big repair bills

And ultimately are restored, by simple adjustment, after many thousands of miles* (when any type of bearing *must* be worn) to function as when new

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TIMKEN
Tapered
ROLLER BEARINGS

A scene on Broadway, New York, in 1890, showing the density of overhead wires

The same scene after the overhead wires were replaced by underground cables

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Darwin's Birthplace.—Mount House, Shrewsbury, with the famous Darwin Walk, a wooded promenade high above the Severn, has been bought by the Office of Works to house its clerks.

Lightning Cooks a Potato.—While a Pennsylvania housewife was paring a potato lightning melted the aluminum knife and cooked the potato to a turn. To the accidental position of her hands at the time she probably owes her life.

Prof. Nernst Wins Nobel Chemistry Prize.—Prof. Walther Nernst of the University of Berlin is awarded the Nobel Prize for 1920 in chemistry by the Swedish Academy. The prizes in chemistry and physics for 1921 are being reserved.

Fossil Forest.—The discovery of a fossil forest is reported at Anglon, Sardinia. Petrified palms, with well-preserved structure, are already known from a Miocene formation in the island, and details of the new find will be awaited with much interest.

Weather Ten Days Hence.—Forecasts recently issued by the British Meteorological Office predicted 10 days of fair weather, probably a record for long-distance weather prediction in England. No doubt wireless figured largely in this innovation, which, if found to be tolerably reliable, promises much for the agriculturist and others.

American Association Exhibits.—The Toronto meeting of the American Association will be marked by an exhibit of scientific apparatus. The University of Toronto will provide space, and exhibits of non-commercial institutions and private individuals will be exempt from the small charge made to commercial organizations to cover expenses.

Paris Looking for Radium.—The Board of Charities of Paris is bidding for one and a half grams of radium for free use in cancer cases. No such quantity is available in France, and as England has acquired all Czecho-Clovakia's reserve much of the 2000 francs allotted for the purchase will doubtless go either to the United States or to England.

To Fly to the Pole.—When Amundsen sails northward next May he will probably take along two airplanes and two aviators. He is himself an expert aviator. His idea is now to fly to the pole, which may indicate an abandonment of the plan to drift across with the ice pack. The expedition is financed by the Norwegian Government, and the schooner "Maud," now at Seattle, is the center of busy preparations for the coming attempt.

A Coffin of Stalagmite.—Dr. Hrdlicka of the National Museum was called to the Luray Caverns of Virginia to investigate some bones that had been discovered embedded in a stalagmite. With some difficulty the whole deposit containing the bones was removed in pieces, and the bones were found to be parts of a human skeleton; but the only trace of the skull was a portion of the lower jaw. The Museum is studying the specimens.

Beheading a Palm.—The big Brazilian cocoanut palm in the New York Botanical Garden acquired the glass-breaking habit. Although the central dome of Range 1 in the Conservatories is 90 feet high, the ambitious palm has several times poked its head through the top. Taking into consideration the high cost of glass and labor, this expensive habit had to be checked, and the verdict was decapitation for the tree. It had previously outgrown its quarters in the Central Park greenhouses.

Photographing Fossils.—A contributor to *Science* suggests some improvements in photographing fossils. He places a dull white background some distance behind the whitened specimen, turning this background at such an angle that it receives the full light but does not reflect it toward the camera. A screen, consisting of two or three thicknesses of cheesecloth on a wire frame, is placed between the specimen and the source of light. Every feature of the fossil is thus brought out.

Ruins of Incredible Age.—Are we on the brink of a revelation of life in the iron and bronze ages? Excavators in the ruins of an ancient village near Rome uncovered several two-room structures of marble, granite and concrete. The metal implements and weapons found seem to indicate an age much more than 50 centuries. There are some who believe the hills around Rome contain remains of every stage of civilization, and that the original founder of the city may have occupied one of these buried villages.

Standard Meter Lengthens.—In 1889 20 nations decided to take their standard of length from a platinum scale; now France, the jealous guardian of this piece of metal, is alarmed to find that it has lengthened by a demimicron, or five-millionths of a meter. The only explanation available is that the annual cleaning of the bar may have been responsible for displacing the platinum molecules. It will be carefully watched for the next ten years and the cleaning may have to be abandoned.

The Making of Mummies.—Dr. Edmond Bartha of Paris, who has for many years studied Egyptian mummies from the chemical point of view, believes he has discovered an embalming fluid that will maintain a lifelike appearance in corpses for from 20 to 50 years. He holds that his fluid is similar to that used in the time of the Pharaohs; but whereas the incisions were then made through the carotid artery, femoral incisions are used in the new practice. The long-lost secret may have been found.

Paris Geographical Society.—The Geographical Society of Paris celebrated its centenary in July last. Having been founded in 1821, it is the oldest geographical society in the world, and nine years senior to the Royal Geographical Society. In commemoration of the event the society has devoted an enlarged number of *La Géographie* (July-August) to a history of the society and a record of the centenary celebrations. From the year of its foundation, under the presidency of the Marquis de Laplace, the society has grown in usefulness and influence.

Orchid Facts.—It has been wrongly assumed that orchids are parasites drawing their sustenance from the trees to which they fasten. Really they live almost entirely upon air. The development of these fantastic flowers has lately received a great impetus in America, due to the law requiring imported stock to be used only for propagating new plants and improving old varieties, instead of being sold outright. King Leopold of Belgium probably did more than any other man in the development and culture of orchids.

Red Snow in America.—Last summer this phenomenon made its appearance in the Rocky Mountain National Park, to the wonder of tourists. The great masses of color present in the snow fields of the higher elevations are due to billions of tiny organisms, half plant, half animal, that have the power of movement, growth and reproduction. The organism is an Arctic species known as *Protococcus nivalis*, and it has been found in Glacier and Mount Ranier National Parks only within the past decade. The color reaches its maximum density about a quarter of an inch below the surface of the snow; on the tongue, its flavor suggests watermelon. It is a mystery how the spore traversed such great distances, but it is supposed to have traveled on the Chinook winds.

Criminal Carelessness.—Five million vacationists take to our national forests every season. In the four years 1916-1920 56,488,307 acres of forested area were burned; this is more than two and a half times the area Germany lost by the war. A very large number of these fires are directly due to the thoughtlessness of tourists; a discarded cigarette stub, a campfire not properly extinguished, and acres of valuable timber that has taken generations to reach its splendid maturity are swept down in flames. The Forest Service wants the public to enjoy the forests; it builds fine roads and sets up free camping grounds for them. Is it too much to expect that in return they will be more careful with their cigarettes, and see that their campfires are thoroughly extinguished?

Miscellaneous Notes

Aerial Map-Making. — Aviators attached to the McCook Field are mapping the Mt. Washington region from an altitude of from 8000 to 10,000 feet.

Workers and Dirty Windows.—English tests showed that factory hands gained from 5 to 15 per cent in efficiency after the factory windows had been cleaned.

Moving Australia.—Checking by radio with time-clocks in France reveals, so authorities say, an error of 100 yards in Australia's latitudinal position on all maps. We may have to move Australia—on our maps.

German Conscience Works Slowly.—The Germans have at last returned the ancient astronomical instruments stolen from Pekin in 1901, among them the earliest known example of equatorial mounting, made about 1279.

Our Fight Against Leprosy. — The chaulmoogra tree of Siam and Burma, which yields the oil successfully used in the treatment of leprosy, is being introduced into this country. A permanent supply of the oil is assured.

Orangeade without Oranges.—Only 10 per cent of this decoction is the real fruit juice; for the rest, we find orange oil, citric acid and coloring matter. Such is the finding of Dr. LaWall, the State chemist of Pennsylvania.

What Is Your Lawn-Mowing Record? —Why should sport have a monopoly of "records"? A lawnmower meter may now be purchased in New York registering not mileage but footage. Already a suburbanite is boasting that he has exceeded the record of his nearest competitor by 10,000 feet.

New Radium Deposits.—A Belgian mission sent to the Katanga district of the Congo is said to have found extensive radium-bearing deposits. During the war a Belgian sold in London colcolite rich in radium. He refused to divulge its source, but the Belgian Government immediately instituted a search that led to the Katanga country.

Machines Increase Wages.—In the United States, as compared with Great Britain, our nearest competitor, says *Machinery*, production per man is 2.6 times as great, the output per man is twice as great, and wages correspondingly higher. The cause is found in the fact that we use three times the mechanical horsepower per worker that England does.

Leather Made of Explosives.—The latest exploit of Henry Ford is to buy 35,000,000 pounds of deteriorating cordite gunpowder at one-fifth war-time quotations, and use it for making artificial leather. Besides halving the cost of leather, of which 25,000 square yards are turned out daily, this also releases for other purposes more than a million gallons of benzol annually.

Chimney Efficiency.—A round chimney, while not so easy to build as a square one, has decided advantages over the latter. It greatly lessens the friction between the walls of the chimney and the rising gases, and has the smallest wall surface in proportion to the cross area. The efficiency of a round chimney 24 inches in diameter is almost as great as that of a square chimney 24 inches across.

Victims of Peace.—As a destroyer of human life the war, with its record of 48,000 American dead, is pressed hard by our industries, which claimed 35,000 victims in the same period of nineteen months. On September 4, Labor Sunday, the subject of the responsibility of the Church in industry was taken up in our pulpits at the suggestion of the Federal Council, with a view to awakening interest in the safety of those who tend our high-speed machinery and shoulder the risks that, inseparable from such occupations, may yet be greatly reduced by proper methods.

Removing Ink Stains from Negatives and Prints.—It is not often, remarks a correspondent of the *British Journal of Photography*, that a negative or print is damaged by ink. A quick solvent is sulfuric acid. It should not be used stronger than one part in four of water, and if diluted from a concentrated fluid great care should be taken to pour the acid into the water and not vice versa. At the strength of one in five the acid is safe to fingers and photographs, and will remove ink without injury to gelatine or silver. There is no need to prepare a dishful, a spot or two applied with a small brush should be sufficient. A short washing afterward is necessary.

Metal Case for 1" Starrett Micrometers

Many appreciative users of fine Starrett micrometers have expressed a desire for a micrometer case rather more highly finished and substantial than ordinary micrometer cases, and adapted to carry 1-inch size micrometers—this, of course, being the size in greatest use.

To meet this demand The L. S. Starrett Company now offers a very handsome metal case finely nickel-plated, lined with black velvet and made to accommodate a Starrett micrometer of the above size, with adjusting wrench. The case has neatly rounded corners and is very compact: Outside dimensions are approximately 13/16 inch thick, 2¼ inch wide and 5½ inch long. Weight about 7 ounces. An illustration, showing the neat appearance and arrangement of this case, can be seen in the new Starrett Supplement to Starrett Catalog No. 22, copies of which may be obtained without cost from The L. S. Starrett Co., Athol, Mass.

New Micrometer Depth Gage with 1" Screw Added to Starrett Line

Numerous mechanics favoring a depth gage having a 1-inch movement of the screw will welcome the recent addition of such a gage to the Starrett Line. The new Starrett gage—Starrett Micrometer Depth Gage No. 440—is designed to measure the depths of holes, projections, etc., from 0 to 3 inches by thousandths of an inch. With each Gage is included three measuring rods having hardened and lapped ends. The rods can be easily and quickly inserted through a hole in the screw and brought to a positive seat by a small knurled nut.

This Gage is supplied in two types differing in the length of base. No. 440-A has a 2½ inch base, and No. 440-B has a 4 inch base. Thickness of base is about 4/10 inch. Bases are hardened, ground and lapped. Gages are furnished with or without cases.

These Starrett No. 440 Micrometer Depth Gages are illustrated and described, with other new Starrett Tools, in a special Supplement to Starrett Catalog No. 22. Copies of this Catalog and the new Supplement will be sent without charge to all interested parties by The L. S. Starrett Company, Athol, Mass.

Civil Engineering Notes

Abstracts of Important Recent Papers and Published Articles

Process Metal Roofs.—The wearing qualities of a new process metal material for roofs, siding and trim have attracted considerable attention. This process metal is built up on a steel basis. Three impervious coatings are applied— namely, asphalt, asbestos, and waterproofing. These coatings envelop the sides, edges and ends, and make it impossible for destructive elements to reach the specially annealed steel core.

Electrification of Italian Railways.—From Consular sources we learn that the Director General of the State Railways of Italy is suggesting that the Italian Government have the reparations account settled in part by requiring the Germans to hand over material which could be used in electrifying Government railways. The office of the auditor general is said to oppose this means of settlement and to consider it preferable to have the adjustment of reparations made on a strictly money basis.

An Unusual Test for an Arch.—A reinforced concrete arch of 86 feet span, forming part of a highway bridge constructed the year before last at Herkimer, N. Y., was submitted to an unexpected and severe test when the work of concreting had been completed only 12 hours. Owing to heavy rains during the deposition of the concrete, the water in the river spanned by the bridge rose about five feet, washing out or undermining the supports of the centering and carrying away part of the latter to such an extent as to leave the arch entirely without support, save that afforded by the molds in which the concrete had been deposited. Notwithstanding the sudden strain so imposed on the concrete, no injury was caused in any part of the arch.

Britain and the World's Ships.—About 62.7 per cent of the world's shipbuilding is being done in British shipyards, according to *Commerce Reports.* Of this amount nearly all is in the United Kingdom; yet there is serious depression in the shipbuilding industry. Of the 3,500,000 tons of shipping now building, 2,750,000 tons are almost completed. Only about four months' full-time work is in sight and very few orders are coming in. The tonnage on which work has been suspended was 731,000 on October 1, and tonnage delayed in completion was 457,000 tons. These two items total 36 per cent of the amount under construction. Work on Britain's four latest post-Jutland battleships has been suspended in support of the limitation of armaments conference.

English Articulated Trains.—An articulated train put in service recently by the Great Northern Railway of England, consists of five cars mounted on six four-wheeled trucks, there being a truck at each end and one under each of the short vestibuled connections between the cars, according to *Engineering News-Record.* A 40-foot kitchen car is at the middle of the train with a first-class 45-foot dining car and a 55-foot coach at one end and a third-class dining car and coach at the other end. All cooking is done by electricity. This train is for a four-hour run between London and Leeds, making a round trip daily. The purpose of the design is to reduce dead weight. Thus, the train is 246 feet long, accommodates 128 passengers and weighs 118 tons on twelve axles. The ordinary train previously used consisted of four cars 60 and 65 feet long, of which the two dining cars (with kitchen in one car) had six-wheel trucks. This older train was 256 feet long, accommodated only 110 passengers, and weighed 139 tons on twenty axles.

Deepening the St. Lawrence.—A statement issued by the Deep Waterways and Power Association previous to holding its annual meeting at Hamilton, Ontario, recently, points out that "the deepening of the St. Lawrence River channels and the enlargement of the canals so as to permit ocean vessels to enter and navigate the Great Lakes is a matter of vital importance to Ontario. At this time when the continued high freight rates are recognized as the principal obstacles to a reduction in living costs the benefits that would result from a through water rate from European points to Great Lake ports cannot be overestimated. "When it is remembered that engineers of the Governments of Canada and the United States have reported that the improvement of the St. Lawrence waterways and the development of an initial block of electrical energy totalling 1,460,000 horsepower can be carried through for an expenditure of $252,000,000, and that the sale of the power will finance the entire undertaking, it will be realized that the fulfilment of this splendid project is much nearer than most people realize," continues our authority.

Sweden's New Locomotives.—There is marked activity on Swedish railways at the present time. Heavier rails are being laid, stocks of ties creosoted, and additional improvements are being planned for 1922, as a means of solving the unemployment problem. The German motor locomotives of the large, heavy type have recently been put in operation in the passenger service of the State railways. Perhaps the most important development in southern Sweden has been the completion of the largest Diesel-motor locomotive in the world—the fourteenth car of this type built in a Swedish factory. The locomotive is driven by a 250-horsepower electric type Diesel engine making 500 revolutions per minute, and can draw four heavily loaded Pullmans at 60 miles per hour. Only one man is required to operate it; and in a trial run of 590 kilometers the fuel cost was less than 20 cents per mile, demonstrating the economical possibilities of this type of car. Satisfactory tests of a new type of steam turbine have been completed, and the engine is said to be so superior in design and construction and economical in operation as to warrant the statement that it will rapidly replace those now in use.

Our Building Activities.—From the civic development department of the Chamber of Commerce, which has recently made a survey of building activities in cities of over 25,000 inhabitants, we have obtained some interesting figures regarding building activities in 1920. Complete and partial reports were received from 131 cities representing a total population of 30,000,000. In 1920, 70 per cent of the families provided for got one-family dwellings; 11 per cent, two-family dwellings, and 19 per cent, apartments in multi-family dwellings. It is also shown that the proportion of multi-family dwellings that were provided in 1920 was largest in the small cities which have not had as much experience in this type of habitation. More house building in proportion to population was found in the smaller than the larger cities. Of the estimated $1,043,000,000 spent on buildings in 1920 in the cities reporting over 36 per cent was devoted to dwellings. Factories and workshops came second with 16.8 per cent; stores and mercantile buildings third with 13.3 per cent, while office buildings and garages tied for fourth place with 8.2 per cent each. Schools, hospitals, and charitable buildings together called for an expenditure in excess of $77,000,000.

Poured Concrete Houses in Germany.—A novel method of constructing concrete buildings has been developed in Germany. The basic principle of the method is the molding of complete houses with lean slag concrete, poured in at the highest point of the erected forms. Forms are made in standard parts from wood, and can be used up to twelve times. They can be erected either for the whole building, or in sections of from one to two floors. The mechanical qualities of the concrete thus obtained have been made the subject of extensive tests by the material testing institute in Berlin, according to *Engineering News-Record.* The erection of the forms, the molding, and the removal of the forms for one four-family house of two stories, continues our authority, has occupied twelve to thirteen days, including six days for the setting. Nineteen workmen were employed on this building for six to seven days. The concrete of this mixture is a bad conductor of heat, and therefore keeps the rooms warm. It is further claimed that nails can be driven in without using dowels, and that it is soft under the chisel, which facilitates plumbing work. The costs for a building of the size mentioned are around 40 per cent below those of a brick building of corresponding size.

Mechanical Engineering Notes

Torch Used Under Water.—French naval men have improved the oxy-acetylene torch so that it can be used under water. A small bell-shaped vessel surrounding the flame is kept supplied with compressed air; the torch may then be plunged into water without going out. Should it become extinguished by accident the diver need not ascend to relight it. On removing the cap from an attached tube containing an alkaline metal and an oxidizer the chemical action of water on the mixture produces a flame that relights the torch.

Germany's Hydro-Electric Plans.—Due to the remarkable utilization of her brown coal deposits, Germany, so we have believed for quite a while, has not had to turn to hydro-electric developments for want of power. However, we learn from a recent issue of *Zeitschrift des Vereines deutscher Ingenieure* that such is not the case. Germany is beginning to consider hydro-electric developments quite as ambitious as those being planned in other countries. Plans are under way to harness available water power in various parts of the Republic, not only for hydro-electric purposes, but for irrigation and better water transport as well.

European Machinery.—We are in the habit of looking upon Europeans as being far behind us in the matter of mechanical equipment and manufacturing process. We point with pride to our conveyor systems, industrial tractors, automatic lathes, battery drill presses, elevator trucks, and so on, and talk about our quantity production methods as if all of these things were unknown to the French, British, and German manufacturers. In preparing some of the material for this department we have waded through a number of British, German and French industrial journals, and we find page after page of advertisements on all manner of equipment, ranging from the modest industrial truck and tractor to the electric crane. Europeans have much the same equipment as we have, and their methods are more and more partaking of our quantity production idea. The Europeans call this idea the American system of manufacture, or manufacture in series. What with lower wages, longer hours, the low rate of exchange and other factors, the European industrialists, now that they have equipment comparable with our own, can be expected to give a good account of themselves in the international markets.

Metal Fatigue Under Repeated Stresses.—The development of the internal combustion engine, the steam turbine, the automobile, and the airplane has made the study of the fatigue of metals of increasing importance. Much information relating to this subject was given in a paper by H. F. Moore and J. B. Kommers, recently read before the American Iron and Steel Institute. The failure of machine parts under repeated stress has come to be commonly spoken of as due to "fatigue" of the metal. The cause of such failure was at one time thought to be the "crystallization" of the metal. In the paper referred to it is shown that the phenomenon is one of a breaking up of crystals rather than of their formation.

The accompanying table, which gives some idea of the number of repetitions of stress in the normal life of various structural and machine members, was prepared by *Machinery* from the data supplied in the paper referred to.

RESULTS OF STRESS TESTS

Part of Structure or Machine.	Approx. No. of Repetitions of Stress in the Life of the Structure or Machine
Railroad bridge, chord members	2,000,000
Elevated railroad structure, floor beams	40,000,000
Railroad rail, locomotive wheel loads	500,000
Railroad, rail, car-wheel loads	15,000,000
Airplane engine crankshaft	18,000,000
Car axles	50,000,000
Automobile engine crankshaft	120,000,000
Line shafting in shops	360,000,000
Steam engine, piston-rods, connecting rods and crankshafts	1,000,000,000
Steam turbine shafts, bending stresses	15,000,000,000
Steam turbine blades	250,000,000,000

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc. This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14383) G. C. G. says: I would like to know just how ice skates should be filed or sharpened and (2) how fastened to the shoes to get the best results. (3) If you can give me any information about the proper care of skates I will be grateful. A. (1) When skate blades have become dulled or chipped, or otherwise injured, they should be reground by competent workmen who understand about the proper grooving of blades. When regrinding, the blades should be emeried and oil-stoned, thereby avoiding the burr which gives the feeling of sticking to the ice. When sharpening tubular racing skates first use a coarse stone to grind blades straight and finish up on a fine stone. This makes a perfectly flat surface on the blade and a nice keen edge. (2) The best recognized practice for attaching ice skates to shoes is to set the skate so that the runner centers on the ball of the foot and the heel. If a person's ankle is weak it is advisable to set the skate slightly off center on the weak side—still keeping the skate in a straight line with the foot. (3) Special care should be given to the skates, especially at the close of the skating season. The foot plates and blades should be carefully rubbed off to prevent rust, and a coating of oil or vaseline applied, otherwise they will not be in condition for immediate use at the beginning of the next season.

(14384) B. R. T. says: Christmas is coming and I want to make some sham snow for Christmas tree. A. The cotton frequently used on Christmas trees to give the effect of snow is extremely dangerous. The very best substance to be used for this purpose is pure white "mineral wool"—*i.e.*, asbestos, when this can be obtained. Otherwise the cotton should be rendered incombustible; and this object, it is said, can be attained by saturating the cotton with a saturated solution of sodium tungstate. You can buy artificial snow very cheaply. Some of the varieties we have seen appear to be only ground mica.

(14385) A. S. says: 1. Does cloth, glass, copper and steel retain their tensile strength at a temperature of absolute zero? If not in what proportion do they lose it? 2. Does the contraction of metals which is fairly constant at ordinary temperature hold good when absolute zero is reached? 3. Is any known gas able to penetrate glass or a metal plate? 4. If we imagined a body able to attain the velocity of light in vacuum, would the ether offer any resistance? 5. If we imagined a human being located on such a body would he be able to "see" anything of what is behind him, ahead of him or at right angles to such motion? 6. In sending wireless signals "around the earth" does it travel around the earth or through it? A. 1. Metals are greatly increased in tensile strength by cooling to low temperatures. Probably this increase of tenacity would continue to absolute zero, although nothing has been cooled to absolute zero. That temperature has never been reached. The melting point of helium, the last gas to be solidified, is given by Olsen, *Chemical Annual*, as -269 C. This is 3 degrees absolute. About cloth and glass we have no data. 2. We have no data for the contraction of metals at very low temperatures. See answer above for absolute zero on this matter. 3. Hydrogen will penetrate red-hot cast iron. As to glass, we do not know any case of such penetration. 4. We have no facts bearing upon the effect of

ether upon a body moving with the velocity of light. The motion of light is a wave motion and not a motion of translation of a material body. No known body is moving with the velocity of light. 5. Light from in front of your imaginary body would come with twice the velocity it has at present. It would not affect the optic nerve as at present constituted. We can not see by a vibration of half the wave length of light. At present vision ceases at a wave length of about 150 ten millionths of an inch. At half this wave length we could not see. The eye can not appreciate twice this velocity or half this wave length. Light from behind us could not overtake us, and hence nothing could be seen to the rear. Light from either hand by aberration would seem to come from an angle of 45 degrees in front of its real course. 6. Wireless waves in part follow the earth's surface and one-half of the wave is in the earth and one-half above the surface of the earth. Another part goes off into space. "The Principles Underlying Radio Communication" is a good book on this subject. It is one of the instruction books for the Signal Service, U. S. Army.

(14386) J. J. McA. asks: When was coal first introduced? A. Coal seems to have been used for fuel by ancient Britons, but the first proper notice we have is that it was mined in Newcastle, 1233; forbidden to be burnt in England, 1273. Nobility and gentry of London petition against use of, 1306. Not in general use in England until 1625.

(14387) E. W. B., Jr., asks for a formula for dentist's molding wax. A. Stearine, 25 parts; half soft copal, 25 parts; talc, 50 parts; carmine, 0.5 parts; oil of rose geranium, 2 drops to 1 oz. Melt the rosin by the heat of a sand bath, and when slightly cooled add the stearine, stirring constantly. When this has melted add the other ingredients, previously intimately mixed, and stir so that a homogeneous product may be obtained. The adhesiveness of the composition may be increased or diminished by modification of the amount of copal. A more thorough blending of the color may be insured by dissolving the carmine in a little potash solution before mixing with the chalk.

(14388) J. B. W. asks: When were iron cables introduced? A. Hempen cables employed by British navy prior to 1811, when iron cables were introduced. First successful submarine cable between S. Foreland and Sangatte, 1851; first Atlantic cable established July 29-Aug. 16, 1857.

(14389) C. M. A. asks how the French clean and prepare bones for exhibition purposes. A. The curators of the anatomical museum of the Jardin des Plantes have found that the spirits of turpentine is very efficacious in removing the disagreeable odor and fatty emanations of bones or ivory, while it leaves them beautifully bleached. The articles should be exposed in the fluid for 3 or 4 days in the sun, or a little longer if in the shade. They should rest upon strips of zinc, so as to be a fraction of an inch above the bottom of the glass vessel employed. The turpentine acts as an oxidizing agent, and the product of the combustion is an acid liquor, which sinks to the bottom and strongly attacks the ivory if allowed to touch it.

(14390) A. C. N. asks: Who invented bleaching? A. Invented by Dutch; first bleach-field in Scotland estab. at Salton, about 1730; intro. into England 1768; Berthollet's discoveries with chlorine, about 1785; Tennant's patent, 1798; Mather's improvements, 1885.

(14391) R. L. K. asks for principal dates in relation to exploration of the Antarctic regions. A. Land discovered in these regions by Capt. Biscoe, Feb., 1831; by Capt. D'Urville, 1838. Principal expeditions to C. E. Borchgrevink lands at Cape Adair, Feb. 23, 1895, 2nd expedition equipped by Sir Geo. Newnes, reached Cape Adair Feb. 17, 1899. De Gerlache expedition, Aug. 16, 1897-Mar. 28, 1899; German expedition, under Capt. H. Ruser, Aug. 11, 1901; British expedition under Capt. Scott, Dec. 24, 1901-Sept. 10, 1904; Dr. Bruce's Scottish expedition, Jan., 1903-July, 1904; Dr. Jean Charcot, French expedition, 1904-05 and 1908-10; Lieut. Shackleton's (now Sir Ernest) expedition, 1907-09; Dr. David, with Mr. D. Mawson and Dr. Mackay, found the S. magnetic pole to be at 72° 25′ S. 155° 16′ E. on Jan. 16, 1909; Capt. Amundsen's expedition, 1910, South Pole reached Dec. 16, 1911; Capt. Scott, British expedition, 1910-13. (Capt. Scott was found dead by a search party, Nov. 12, 1913.)

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Patent Law in Japan.—The patent and trademark laws of Japan have recently been amended and numerous changes made therein. Of interest is the first of these, which, briefly, is to the following effect. A patent is to be awarded to the first applicant instead of to the first inventor, and in case there are two or more applications with regard to an identical invention, filed on the same day, a patent will be granted according to the terms of agreement between or among the applicants. When no such agreement can be arrived at the patent will be granted to none. In this way all provisions for interference proceedings have been abolished.

Patent Infringement After Decree Punishable as Contempt.—A patent right is a civil right, and violation of a patent right constitutes a civil injury for which the law provides compensation, in the form of damages. However, under certain circumstances, infringement of a patent may be punished, in effect, as if it were a crime. Thus, violation of an injunction restraining patent infringement is contempt of Court and may be punished by fine, by imprisonment, or by both. A case of this kind was recently decided in the United States Circuit Court of Appeals of the Second Circuit, *Schey vs. Giovanna*, in which it was held that a certain change on an infringing device, by a defendant, after a decree and injunction against him, was merely colorable, and his use or sale of the changed device is therefore punishable as contempt of Court.

Trade-Mark "Mutt and Jeff".—The Supreme Court of the United States has rendered a final adjudication of the trademark rights in the title "Mutt and Jeff," as indicating the humorous cartoons originated by H. C. Fisher, and widely exploited and syndicated throughout the country in various newspapers. An effect of the decision is that the proprietary right to "Mutt and Jeff" as characters is possessed by Fisher, the originator, and that decisions to that effect in the New York State Courts are binding. The Supreme Court awarded to Fisher the exclusive right to the reproduction of the characters which he originated, and adjudged the reproduction of these characters by others in effect to constitute unfair competition. The Court refused to entertain the contention of the defendant that Fisher could only copyright particular postures or statements descriptive of their exploits, or that the two characters as he had devised them had become public property.

Effect of Prior Interference on Issued Patent.—As a general rule, the declaration of an interference proceeding in the Patent Office causes no joy to either of the applicants or patentees involved. It usually means added expense, and delay. But even an interference proceeding is not without its advantages. The Supreme Court of the United States, in a recent, interesting decision (Hildreth vs. Mastoras, decided November 7, 1921), has pointed out one effect of such an interference, which is of interest: that the presumption of priority and novelty which arises from the granting of a patent must have greatly increased weight when the claim of the inventor is subjected to close and careful scrutiny under the stimulus of an interference contest. Furthermore, the rule has long been laid down, though not referred to in the above decision, that in the event of subsequent litigation based upon a patent previously involved in an interference proceeding, a preliminary injunction will generally be granted one suing upon the patent, where the defendant is the losing party in the interference.

Trade-Marks and Trade-Names Distinguished.—A trade-name can be distinguished from a trade-mark in that the former is either a word or combination of words serving to distinguish a certain manufacturer or merchant and his specific merchandise, which word or words, although not capable of exclusive appropriation, nor registerable in the Patent Office as a technical trade-mark, will nevertheless be protected within certain limits by the Courts from general use by competitors through the doctrine of unfair competition; while, on the other hand, a technical trade-mark is capable of exclusive appropriation, can be registered in the United States Patent Office, and an infringer may be proceeded against under the provisions of the Federal Trade-Mark Statutes.

Such words, therefore, as "Wanamaker," "Hygeia," "The American Girl," "Flare Front," "Waltham," etc., are trade-names which will be protected by Courts of Equity, through the application of the law of unfair competition, while "Kodak," "Coca-Cola," "Jell-O," etc., are trade-marks capable of Federal registration, and infringers may be proceeded against directly under the provisions of the Trade-Mark Statutes.

Curtiss First to Invent Hydroairplane.—In a recent decision of great public interest, the United States Circuit Court of Appeals for the second Circuit has held that Glenn H. Curtiss, of airplane fame, was the first to invent a flying machine that could rise from and alight upon the water, and established Curtiss's right to a broad patent covering the hydroairplane. This decision reverses that of the lower Court, the United States District Court for the Eastern District of New York. The litigation grew out of an application for a patent, filed August 22, 1911, by Curtiss, who, during the preceding January had tested his so-called flying boat in the harbor of San Diego, California, in a successful flight with an air machine equipped with a boat-like hull and with the wings buoyed with small pontoons. This was on January 26th, the same day on which one Janin filed his application for a patent. The case turned largely on the actual reduction to practice by Curtiss, at San Diego. The Court held that this reduction entitled Curtiss to the broad patent, as Janin's invention at the time of this test, and even later, when the application of Curtiss was filed, had not advanced beyond the theoretical stage. The Court said, *inter alia:* "The reason for this holding is that whatever Janin conceived prior to January 26, 1911, whatever experiments or models he made, it is admitted that the fruit of all that he had done was contained in the specification he then filed. If, therefore, that specification does not enable the man skilled in the art to construct, without further exercise of the inventive faculty, an operative hydroairplane, there has been no reduction to practice, constructive or otherwise."

The Condition of the Patent Office.—The unfortunate condition in which the Patent Office finds itself, because of enormous pressure of work and numerically inadequate personnel, is fortunately being given a great deal of publicity in newspapers and technical periodicals of the country. Various associations interested, such as the New York County Lawyers' Association, the American Society of Mechanical Engineers and others, are exerting every pressure to expedite pending Congressional action to remedy this situation. As has been already stated in these columns, the Patent Office is nearly 60,000 cases in arrears. A large proportion of its trained staff has resigned to take up more lucrative work, and in the seventy years past, the pay of the Patent Office personnel has been increased *but 10 per cent.* Surely, this needs no further comment. Nor is it necessary to say anything in regard to the bearing of the work of the Patent Office on the industrial, commercial and economic life of the country. Certainly, there can be no governmental function of greater importance than that which is largely instrumental in fostering the development of invention and the protection thereof. Great pressure is being brought to bear to further the passage of the Lampert Bill in Congress, which will result in a complete reorganization of the Patent Office, and will provide a sadly needed increase in the salaries of its employes. Further, the very fact that this bill has the hearty endorsement of some two thousand members of the American Society of Mechanical Engineers, to say nothing of the rank and file of the legal profession, is indicative of the importance of the proposed legislation and its need.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Electric Steam Generator.—In a paper recently presented before the American Electrochemical Society, Messrs. Lidbury and Stamps give a description of an inexpensive form of apparatus and its method of employment for generation of steam by means of alternating current at voltages from 100 to 500. This apparatus is particularly adapted to a plant which operates its own hydro-electric installation or purchases blocks of hydro-electric power and has available at times energy which it can use at little or no additional cost. Under such conditions considerable saving in fuel may be made by use of the electric boiler.

A Million-Volt Transformer of 1000 KVA capacity is being built by a leading electric company for its experimental laboratory at Trafford City, Pa. The windings of this transformer contain nearly 70 miles of wire. The transformer is built on the principle of distributing the electrostatic stress as developed by C. L. Fortescue of the Westinghouse Company some eight years ago. The terminal bushing is the largest ever built in the Westinghouse shops. Special machines had to be fitted to turn the bushing on this account. Its length is 19 feet, and it is 41½ inches in diameter. The static shield will be 10 feet in diameter and 20 inches deep. The bushing will weigh about 9000 pounds when completed.

Valve Amplifiers in Cable Work.—Amplifiers of the valve or vacuum tube type are being applied to cable work, but no results have yet emerged, except for a solitary German note on the subject, so we learn from *The Electrician*. The capabilities of a modern amplifying device applied to a submarine cable are far in advance of the ability to take advantage of them. With supersensitive receiving devices the duplex balance requires refining to a degree which does not seem possible technically or commercially. Moreover, a long submarine cable stretched from continent to continent collects disturbances not apparent on the ordinary siphon recorder, and we can only reckon on an increase of cable speed of about 50 per cent as a matter of routine, when such amplifiers are employed.

Telephone Cables and Amplifiers.—An interesting account of the history and development of the art of telephoning over long distances, through cables beginning with Professor Pupin's loading coils, their calculations and present use, is contained in a recent issue of *Electrotechnische Zeitschrift*. The Krarup system of increasing the inductance of a cable by winding a layer of iron wire upon the copper conductors is mentioned as the second step. This system is used, for example, on the long submarine telephone cable in East Prussia. Then came the Brown microphone amplifier, based upon the electromagnetic principle, but never used practically, as it was superseded by the Lieben amplifier in 1910, which was the forerunner of the vacuum tube, and finally the present-day high-vacuum electron tubes.

Electioneering by Radio.—For the first time in the history of electioneering candidates were able to talk to the public without the latter leaving their homes. This was done by means of the Westinghouse radio telephone broadcasting station at Pittsburgh, where the speeches were made by the candidates. The nominations for mayor proved a very bitter fight in Pittsburgh, and radio was called into play to get the messages of the candidates to the people. In this way thousands of persons were addressed at one time without the inconvenience of leaving their own radio set. Each candidate for mayor was sent to the broadcasting station, where he was allowed five minutes to tell the reasons why he should be elected to the office. This proved to be quite popular and excited no little interest in Pittsburgh and vicinity.

New Use for Electric Water Heater.—Still another type of electric hot water heater has made its appearance on the market, indicating the growing demand for devices of this kind. This latest type is not an instantaneous heater. The standard sized heater of this type supplies sufficient hot water and in large enough quantities (15 gallons per hour) for any household use with a maximum current consumption of 16 amperes. It operates on either alternating or direct current, 110 volts. Its operation is controlled by a three-heat switch, making it possible to regulate both the quantity of hot water and the temperature. The heating unit can be readily removed without the necessity of drawing off water from the tank. One ingenious application for this heater is in connection with hot water radiators, where one heater may serve to operate a single radiator in instances where it would not pay to start up the entire heating system.

New Uses for the Telegraphone.—In the telegraphone devised many years ago by Poulsen a telephonic conversation was "fixed" by magnetic action upon a steel ribbon or a steel wire and could be reproduced later by passing this ribbon again over a small electromagnet in the winding of which a fluctuating voltage was set up which in turn energized a telephone receiver. The results obtained with this apparatus did not warrant its more general use, on account of the faintness of the reproduction. Since, however, the modern vacuum tube came into vogue it has been possible to amplify the sound to any degree, and A. Nasarischwily, in *Electrotechnische Zeitschrift*, states that he has constructed an electromagnetic phonograph on the combined principles of the telegraphone and the amplifying tube. He shows further that with this method a message may be "spoken into" a rail and picked up by the engineer of the train following. Here is a suggestion that might be of great value for railway signalling purposes.

Something New About Batteries.—When storage batteries or dry cells are cooled down to minus 170 deg. C., the temperature of liquid air, these producers of electricity may reverse their voltage. This is the scientifically startling phenomenon that has been discovered at the Bureau of Standards by G. W. Vinal and F. W. Altrup, who were making tests to determine the reliability of batteries at arctic temperatures. So far as is known, this is the first time this phenomenon has been observed. Down to 80 deg. below zero the voltage remained at the normal value. At about minus 100 deg. C. the voltage dropped down to nothing, and then, at a slightly lower temperature, strangely registered a minus reading as high as 10 volts. The voltage fluctuated violently, ranging from positive 10 volts to negative 10 volts. These reversals happened whenever the frozen electrolyte of the cell "ticked." No hope is held out by the Bureau of Standards that storage batteries can be recharged by the simple method of cooling them to the low temperatures used in the tests. The currents at these low temperatures are vanishingly small, and practically they hardly exist.

Pilotless Warship.—A boat built by the French Navy during the war was controlled from an airplane. The construction of the control mechanism is described in a note appearing in a recent issue of *Electrical World*. This boat was patterned after a German pilotless boat which attacked a French pier. The German boat was driven by a gasoline motor and electrically controlled by means of a 30-mile one-conductor cable. The boat contained two gasoline motors such as are used on zeppelins, operating twin-screw propellers capable of giving the boat a top speed of 40 knots per hour. Seven distinct operations of the engine and the rudder could be performed by means of the remote electric control. The control was essentially by means of a ratchet mechanism, a different number of ratchet impulses corresponding to certain actions of the boat. A small gasoline-electric generator set and a storage battery furnished the energy for the operation of the different motions. A special time relay was in series with each of the seven distinct positions, so that every one of the different operations was executed only after the contact-making ratchet mechanism stopped for a certain minimum time on a given position. In case of imminent danger to the boat an eighth position of the contact apparatus was provided for the self-destruction of the boat by ignition of its own charge.

The Last Word in Illuminated Highways

(Continued from page 97)

others' light. The real trick about the assembly, after having got the focal lengths and curvatures of the several mirrors just right, lies in the relative position of the lamp, the rear cut edges of the mirrors, and their front cut edges. Reference to the sectional drawing will show that the lamp, the inner edge of the second mirror, and the outer edge of the first one are all in line. This means that the light which would pass outside the opening of the outer mirror and escape reflection altogether is that with which the central mirror works. And a similar relation exists between the second and the third mirrors. The inner reflector is of sufficiently narrow aperture so that the light that it "wastes" is not really wasted at all; it falls directly upon the road within the zone of illumination.

Finally, in the bottom of each reflector as it hangs on the pole are cut rectangular openings of carefully determined size. It will be realized that none of the three mirrors throws any light to the ground in the immediate vicinity of the pole. The area between the pole and the commencement of the zone of illumination of the outer paraboloid is taken care of by direct light passing through the rectangular gaps; and these are made of just the right size to take care of this area without illuminating any of the region at the side of the road, and without overlapping into the territory of the large mirror.

Two of these nests are joined, back to back, along the cut edges of the outer mirrors, with the lamp in the center. The point where the lamp falls must, of course, be the common focus of all six paraboloids. The two inner mirrors are supported only by the cross-rods, which are seen clearly at the front in our photograph, and less clearly at the back. The whole outfit is now hung from the pole on a universal bracket which permits of tilting the reflector up at either side so that it shall lie at the proper angle to a sloping road, swinging it inward or outward to meet a curve in the highway, and swinging it bodily a short distance up or down to dodge an obstacle which would otherwise throw a shadow on the road.

That the reflector is really two reflectors joined is emphasized when it is viewed, lighted, from the road. The nest of mirrors on the other side of the pole from the spectator turns its dark side, and this is unilluminated; so it is wholly invisible. One can hardly believe that the reflector is a two-sided one until one goes around to the other side of the pole, when the side he has been looking at disappears and the other springs into view. From no point does the reflector give glare; it seems rather like one of those big diffused lights that are so easy to look at.

A trial installation has been made on several miles of the Albany highway out of Schenectady. Owing to the extreme glare from trolley headlights, the high speed induced by the long straight road, the tricky character of the roadside where blind culverts and fills encroach seriously, and the pleasant habit the residents along the way have developed of using the middle of the road as a promenade at all times and all places and under all circumstances, the road has earned an unenviable reputation as the scene of fatal accidents. The poles have been placed for the most part 400 feet apart. Little is gained where for experimental purposes they have been spaced 300 feet; but spacings of 500 and 600 feet show noticeable inferiority. The lamp is an ordinary 250-candlepower affair, making the cost of operation little if any in excess of that of the customary ineffective highway installations. The lamps are attached to the poles at heights of 30 or 35 feet. They have been put on existing poles, so no serious effort to compare staggered settings with all-on-a-side could be made.

With these lights in operation the road is illuminated as I had never imagined I should see a road lighted. We extinguished our headlights completely and drove with ease. The road stretches out before the car in an unbroken ribbon of light—a ribbon of light lined with inky blackness that attests to the efficient concentration of the light where it is wanted. Anyone who will count the lights that are distinguishable in the accompanying photograph, and make due allowance for the characteristic dispersion on the plate, will have no difficulty in crediting my statement that by counting the lights ahead of us we could assure ourselves that in the absence of intervening hilltops a full half-mile of the road was at all times clearly visible. The concentration of light on the road was such that in some respects visibility was better than in broad daylight. I have my doubts, for instance, that in the daytime I could see a cat crossing the road half a mile ahead; or, seeing it, identify it as a cat without the possibility of error. The feline to which I refer, under the conditions pictured, fairly leaped into the field of vision, and was not to be mistaken for any other animal. Road places in the road far beyond the range of the ordinary headlight stood out clearly; cross ruts that would have thrown an alarming shadow in any other illumination I ever saw were shown in their true character 900 feet away. The illumination is absolutely uniform; there is no suggestion of zones of light and darkness.

Such terms as "revolution" and "epoch-marking" are used far too freely in describing technical advances. But I can conceive of no reason why they should be withheld here. In the presence of this reflector there is no excuse for inefficient highway illumination. My pronouncement of several months back may be modified: a road should be illuminated by this device or a better one, or left dark.

The Heavens in February, 192

(Continued from page 136)

southwest and Aldebaran high in the west. Capella, still higher and north of west, may be counted as a member of the same group, and so also may be Canopus, which is visible low on the southwestern horizon to observers in the Gulf States—though never in the north. Regulus is high in the southwest, and at our hour of observation Spica and Arcturus have just risen.

The Planets

Mercury is in conjunction with the sun on the 14th and is practically invisible except at the very beginning of the month, when he sets an hour and a half later than the sun.

Venus, too, is in conjunction—behind the sun, unlike Mercury, which is in front of him—and can hardly be seen in spite of her great brightness.

Mars comes into quadrature on the 26th. He is then in the western part of Scorpio and rises about 1 A. M. He is steadily approaching us, and is now brighter than the first magnitude, and gaining in light.

Jupiter is in Virgo and rises about 10 P. M. in the middle of the month. Saturn is in the same constellation, but further west, rising about 40 minutes before Jupiter.

Uranus is nominally an evening star, but is too near the sun to be seen. He is in conjunction with the sun on the last day of the month. Neptune comes to opposition on the 4th. He is then in 9h. 8m. 20s. R. A., and 16° 34′ 32″ north declination, and is moving 6.7s. eastward and 30″ northward per day. This places him in the eastern part of Cancer, far from any conspicuous stars, so that an equatorial telescope or a good star chart will be required to find him.

The moon is in her first quarter at 11:52 P. M. on the 4th, full at 8:17 P. M. on the 11th, in her last quarter at 1:18 P. M. on the 18th, and new at 1:48 P. M. on the 26th. She is nearest the earth on the 12th and furthest away on the 26th. During the month she passes near Neptune on the 11th, Saturn on the 14th, Jupiter on the 15th, Mars on the 18th, Mercury on the 24th, and Uranus and Venus on the 26th. The conjunction with Jupiter is fairly close.

Nielsen Carbonization Process

IN view of the attention which has recently been directed to the production of smokeless fuel by low temperature methods of carbonization, it is of interest to note the introduction of a continuously operated mechanical process based on the principle of a revolving retort.

The system is the invention of Mr. Harold Nielsen, who has combined with a slowly revolving retort a means for internal heating with an oxygen-free gas. As smokeless fuel is the primary object, the quality of the permanent gas ultimately obtained is not of any great importance; accordingly, internal carbonization is effected by means of hot producer gas. This is a decided departure from methods at present in use and is deserving of consideration for the reason that, as is well known, carbonization proceeds far more economically and rapidly with heat directly applied, rather than when it is conducted through the walls of a refractory container.